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Hourly and Daily Precipitation Frequencies for the United States

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August 1991

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Engineer Topographic Laboratories
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This report presents daily and hourly precipitation frequencies for an extensive network of stations throughout the United States, from special summaries of observations obtained over the decade 1951-1960. When data are in the format of cumulative percent frequency per precipitation rate, the daily and hourly distributions each form a fairly regular progression, per P/D or P/H, respectively (P = total precipitation, D = days, H = hours). The resultant models, in the form of succinct tables, graphs, or computer programs, provide a ready means for recovering the original observations, or estimating any selected precipitation rate for a wide spectrum of precipitation regimes in the United States, or elsewhere. The models, which serve as a check on data errors, or weather modification, also indicate to the engineer preferred areas for testing particular equipment. The methodology for the comparison among stations (or countries) of the actual short-term precipitation distributions, given only routine climatic data, should be highly useful for assessing more accurately a host of factors, as: soil moisture, trafficability, water supply, crop yields, or possible malfunction of electronic equipment. The greatest advantage of the result is that they may be utilized for estimating short-term precipitation in data sparse localities.

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PREFACE

This report on daily and hourly precipitation frequencies over the United States is part of an army-wide investigation of the "Frequency and Distribution of Natural Battlefield Obscurants," under project QG752CODOI, Work Unit 01. Routine observations of precipitation are usually limited to the total amount of precipitation and its duration in days, per month or year. In this report, frequencies of short-term precipitation (from special summaries) are presented for about 120 stations, encompassing a wide range of precipitation regimes. Such information also contributes to the climatological data base currently being developed at ETL.

Models derived from the above data provide a convenient means of recovering the original observations or estimating any selected precipitation rate, given only total precipitation and its duration. The general methodology, presented previously, but improved somewhat on the basis of the observations at hand, appears to have world-wide application. The results have implication for radar or satellite discrimination of precipitation.

The work was performed under the supervision of Dr. Donald W. Dery, Branch Chief, Environmental Effects Branch; Harold G. Britton, Chief, AirLand Battlefield Environment Division; and Bruce K. Opitz, Director, Geographic Systems Laboratory.

Col. Alan L. Laubscher, CE, was Commander and Director, and Walter E. Boge was Technical Director of the U.S. Army Engineer Topographic Laboratories during the research period. Col. David F. Maune, CE, was Commander and Director at the time of the report publication.

Appreciation is extended to Dr. Richard Gomez for his critical review and to Paul Krause for his assistance with the base maps.

HOURLY AND DAILY PRECIPITATION FREQUENCIES

FOR THE UNITED STATES

INTRODUCTION

Short-term precipitation affects everyday activities, especially military operations, because of the hampering of transportation and the malfunction of electronic equipment. Different precipitation characteristics are associated with different problems. Large raindrops can deteriorate the surface of fast-moving aircraft or vessels. Excessive precipitation causes flash floods, mud, soil erosion, and loss of traction. Deficient rain brings about water shortage and dust. Visibility, therefore, may be reduced at times by either extreme, that is, heavy precipitation or drought.

Intense rain interferes with the transmission of radar signals. With increasing dependence on highly sophisticated sensors for weapons guidance or target acquisition, the military requires knowledge of atmospheric attenuation of electromagnetic radiation under different meteorological conditions. Such attenuation depends on the variation of precipitation intensities throughout the atmosphere and the corresponding drop-size distribution, which factors may be related to or derived from surface observations. Satellite observations of precipitation are also related to ground truth.

Generally, the frequencies of various short-term precipitation rates are not included in ordinary climatological summaries. For the most part, the data consist of total precipitation (P) per month or year, and the associated number of days with measurable precipitation (greater than or equal to 0.25 millimeters for stations in the United States). Although routine observations are obtained for calendar-days (D) or clock-hours (H), a number of investigators have determined for each hourly precipitation rate the corresponding instantaneous precipitation distribution (Briggs and Harker 1969; O'Reilly 1971). Moreover, certain publications contain data for maximum precipitation intensities over selected brief durations [National Oceanic and Atmospheric Administration (NOAA) 1986, United States Weather Bureau (USWB) 1958].

The objective of this study is essentially to determine the temporal and spatial distributions of average hourly and daily precipitation over the United States. This report presents and summarizes the annual frequencies of a spectrum of hourly and daily precipitation rates, observed over a decade for an extensive network of stations, subject to diverse climate and topography. The emphasis is on the overall nature of the various short-term precipitation distributions, rather than on exceedingly high

precipitation rates. Other reports have provided extreme-value statistics [USWB 1955, 1958, 1960, 1966; World Meteorological Organization (WMO) 1973; Lenhard and Sissenwine 1973; and NOAA 1986].

When short-term precipitation is expressed in terms of cumulative percent frequency per cumulative percent amount or per precipitation rate, the resultant skew distribution is reproducible, given only total precipitation and its actual duration (Olascoago 1950; Martin 1964, 1968; Wexler 1986). Berthel and Plank confirmed this principle with respect to instantaneous rainfall observed over an hour of time. These earlier investigations have shown that, with respect to cumulative percent frequencies, the hourly precipitation distributions become a function of P/H and the daily precipitation distributions become a function of P/D.

Accordingly, in this study, the annual precipitation observations are listed first in terms of the number of hours or days per precipitation class. Then the data are converted to cumulative percent frequencies of occurrence, with the stations reordered per P/H or P/D. Graphic and mathematical models developed from reduced tables of these frequencies approximate the original observations. Since the annual precipitation for the United States encompasses a gamut of precipitation regimes, the derived models appear to have general application over the globe.

DATA SOURCES

The principal data source for both hourly and daily precipitation frequencies, for about 120 stations, consists of the series of bulletins entitled, "Summary of Hourly Observations 1951-1960" (U.S. Weather Bureau, 1963-1964). Table 1 lists the stations utilized. About 25% of the cases are for only the 5- year interval, 1956-1960. These are indicated in Table 1 with an asterisk.

Table 2 is an example of the original data shown in its actual size. As shown the daily frequencies are averaged per hour of the day per class per year. In the count of hours per class, the "+," which indicates less than 0.5 hour but more than zero time, is assigned for this study a value of .25 hour. This adjustment tends to give a slightly higher count than only the whole numbers to intensities equal to or greater than 6.35 millimeters (mm) per hour. However, the difference in percent hours per year of such intensities is infinitesimal.

Although the U.S. Weather Bureau bulletins contain various other weather elements, the values of the average precipitation and the average temperature are not in convenient format. Therefore,

C OCCURRENCES OF PRECIPITATION AMOUNTS:

Intensities	FREQUENCY OF OCCURRENCE FOR EACH HOUR OF THE DAY																									[illegible]
	A M HOUR ENDING AT												P M HOUR ENDING AT													
	1	2	3	4	5	6	7	8	9	10	11	Noon	1	2	3	4	5	6	7	8	9	10	11	Mid		
Hours	19	19	19	20	21	21	24	25	19	20	20	20	22	22	21	22	24	20	22	21	20	19	19	19	[illegible]	
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[illegible] and over											[illegible]														[illegible]	
TOTAL	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	

BIRMINGHAM, ALABAMA
Municipal AP

In Tables A and C, occurrences are for the average year (10-year total divided by 10). Values are rounded to the nearest whole number, but not adjusted to make their sums exactly equal to column or row totals. "+" indicates more than 0 but less than 0.5.

TABLE 1. SAMPLE OF ORIGINAL DATA

both of these parameters are obtained elsewhere, as from the **World-Wide Weather Records** (WMO 1973) or the appropriate **Local Climatological Summary** (NOAA annual summaries since 1950). Additional data, utilized for comparisons, are from numerous sources (Sternstein 1962; Panama Canal Company 1957-1971; Winner 1968).

OBSERVATIONS

Table 3 gives, per station, average annual precipitation and various parameters thereof for the decade 1951-1960. Table 4 lists hourly precipitation frequencies and table 5 lists daily precipitation frequencies for the stations in Table 3. Tables 6 and 7, respectively, contain the same data as in tables 4 and 5, except the format has been converted to cumulative percent frequency of occurrence (with respect to precipitation duration only) per P/H and P/D, respectively. The data in tables 6 and 7 are ordered by the increasing value of P/H and P/D, respectively. Tables 8a and 8b, which summarize the latter two tables, contain the average and mean deviation of the precipitation parameters and frequencies, as well as the mean annual temperature for each discrete data set.

Figures 1 and 2 consist of graphic representations of the average hourly and daily precipitation distributions, respectively, per P/H and P/D, as given in table 9, which is a consolidation of tables 8a and 8b. Figures 3a through 3d consist of a series of maps showing the geographical distribution of a variety of precipitation parameters, as H, H/D, P/H, and P/D, respectively. Figure 3e gives percent frequencies of hours per year with precipitation equal to or greater than 6.35 mm, and figure 3f gives percent frequencies of days per year with precipitation equal to or greater than 25.4 mm.

DISCUSSION

Figures 1 and 2, although somewhat similar to those of an earlier study (Wexler 1986), are based on an extensive network of stations within the United States, with summarized frequencies of 5 to 10 years of precipitation data. Each plot represents an average of 10 to 20 stations, except for the end plots, which represent at least 5 stations (mostly for 10 years). The earlier figures were based only on a few stations each, with data from 1 to 3 years.

The listing of P/H or P/D to the hundredth decimal place in tables 6 and 7 is merely for the purpose of establishing a station order, rather than for implying data accuracy. Aside from round-off errors in the original class-frequency tables, the rain gauge, at best, is a poor sampler. Furthermore, either ratio, P/H or P/D, is likely to be biased by a single hour or day, respectively, of extreme precipitation. In any case, precipitation is one of the most erratic of weather parameters, with P, D, or H at any given station varying from year to year, not necessarily consistently. Consequently, representative short-term precipitation distributions require at least 5 to 10 years of data or else a group of stations in a given area.

Perhaps the most surprising results are the relatively great variations of P and H for nearly the same P/H in table 6 and of P and D for nearly the same P/D in table 7. In these tables, the distributions appear to depend on P/H or P/D, respectively, as noted, irrespective of the individual values of P, H, or D. Both P/H and P/D tend to increase in an irregular manner with temperature, mainly because of an increase in P, except for arid regions. The highest values of H and D seem to be associated with orographic lifting or with a maritime (or lake) effect, the result being relatively low values of P/H and P/D in such cases, despite high values of P.

To some extent, the ratio H/D also provides a clue to precipitation-type, a high value (greater than 5.5) implying the predominance of orographic or stratiform precipitation and a low value (less than 4.5) indicating the prevalence of cumuliform precipitation. Except for the Pacific Northwest, with H/D greater than 6.0 and the very dry Southwest, as well as southern Florida, with H/D equal to or less than 3.5, H/D ranges between 4.0 and 5.0 over much of the country. Albuquerque, New Mexico, has the lowest value of H/D of the selected stations, namely about 3.0. Annual averages of H/D mask the disparity of monthly or seasonal H/D's. For instance, Washington, D.C., with an annual H/D of 5.00, has a summer H/D of 3.41 and a winter H/D of 6.52. The summer precipitation consists invariably of brief thundershowers, while the winter precipitation is usually associated with longer lasting storms. The monthly H/D would appear to be a useful, though much overlooked weather parameter.

On an annual basis, certain stations with either fairly high or fairly low temperatures may experience low H/D's for different reasons. Miami and West Palm Beach in the low latitudes, as well as Barrow and Thule in the high latitudes, all have low H/D's, the former because of convective showers, and the latter possibly because much of the precipitation is characterized as a trace rather than a measurable amount per clock-hour, since the climate is too cold to contain much moisture.

ENGINEER AIDS

Figures 1 and 2 and table 9 constitute models of short-term precipitation for essentially the entire United States. These models are least applicable to extremely light precipitation as in Alaska or other sites in exceedingly cold localities. Stations subject to both maritime and orographic effects, as in the Pacific Northwest, also tend to have a preponderance of light precipitation intensities, rather than the general skew distribution found elsewhere.

Tables 6 and 7, based on the actual observations, serve as guides for data sparse stations with similar mean temperatures and associated values of P/H or P/D. If the ratio H/D or P/H can be established for any given area (as from figure 3b or 3c), then H may be readily obtained from D or P, respectively.

Although the observations presented in figures 1 and 2 or tables 6 through 9 provide a clue to precipitation frequencies elsewhere per corresponding P/H or P/D, computer programs are sometimes more convenient to use, especially because of their flexibility. A few examples of such programs are given in the appendix. The principal equations employed have been discussed in detail previously (Wexler 1986). The methodology differs somewhat from the earlier report in that in this case explicit equations were derived specifically from table 9. Appendix A gives a brief explanation of the methodology. Appendix B contains a number of computer programs for estimating hourly precipitation distributions, given only P and H, and for estimating daily precipitation distributions, given only P and D.

The results show that the models provided are applicable to other intervals of time or other localities over the globe. For instance, program #1 is tested for hourly precipitation distributions at stations in Southeast Asia, whereas programs #2 and #3 are tested for daily precipitation distributions per month, season, or year for a variety of sites.

SUMMARY

1) This report presents daily and hourly precipitation distributions for nearly 120 stations throughout the United States, representing a wide range of precipitation regimes.

2) In terms of cumulative percent frequencies per precipitation rate, the hourly or daily distributions form a fairly regular progression per P/H or P/D, respectively, despite individual values of P, H, or D.

3) This study confirms previous investigations that short-term precipitation distributions are reproducible.

4) The resultant models, in the form of tables, graphs, or equations, serve as a convenient means for recovering the original observations or estimating a selected precipitation rate, given any P and H or any P and D.

5) The models also act as a check on data errors, or weather modification, as well as a guide to the engineer in the selection of test sites.

6) The comparisons among stations (or countries) of actual short-term precipitation distributions should lead to more accurate assessment than otherwise possible of a host of factors, such as soil moisture, crop yields, trafficability, water supply, and malfunction of electronic equipment, or impediments to daily activities.

7) The models appear to be valid for monthly or seasonal precipitation regimes, within the limits of the P/H or P/D ranges given, not only for stations in the United States, but for those elsewhere.

8) The ratios P/H and H/D appear to be a significant indicators of precipitation type. High values of P/H are usually associated with high temperatures, except in desert regions, whereas high values of H/D are usually associated with cooler temperatures and/or orographic precipitation or a maritime effect. The results suggest that monthly values of H/D, or P/H would be useful climatic parameters.

9) A particular advantage of the results is that they provide a means for estimating precipitation in data-sparse localities.

TABLE 2. LIST OF STATIONS BY STATE

- 1-ALABAMA
  - Birmingham
  - Montgomery
- 2-ARIZONA
  - Phoenix
  - *Tucson
- 3-ARKANSAS
  - Little Rock
- 4-CALIFORNIA
  - *Bakersfield
  - Burbank
  - Fresno
  - Los Angeles
  - Oakland
  - Sacramento
  - San Diego
  - San Francisco
- 5-COLORADO
  - Denver
- 6-CONNECTICUT
  - *Hartford
- 7-DELAWARE
  - Wilmington
- 8-FLORIDA
  - Jacksonville
  - Miami
  - *Orlando
  - *West Palm Beach
- 9-GEORGIA
  - Atlanta
  - Augusta
  - *Macon
  - Savannah
- 10-IDAHO
  - Boise
- II-ILLINOIS
  - Chicago
  - Moline
  - Springfield
- 12-INDIANA
  - Evansville
  - Fort Wayne
  - Indianapolis
  - *South Bend
- 13-IOWA
  - Des Moines
  - Sioux City
- 14-KANSAS
  - Topeka
- I5-KENTUCKY
  - *Lexington
  - Louisville
- 16-LOUISIANA
  - Baton Rouge
  - Lake Charles
  - New Orleans
- 17-MAINE
  - Portland
- 18-MARYLAND
  - Baltimore
- 19-MASSACHUSETTS
  - Boston
- 20-MICHIGAN
  - Grand Rapids
  - Detroit
- 21-MINNESOTA
  - Duluth
  - Minneapolis
- 22-MISSISSIPPI
  - Jackson
- 23-MISSOURI
  - Kansas City
  - St. Louis
  - Springfield
- 24-MONTANA
  - Great Falls
- 25-NEBRASKA
  - Omaha
- 26-NEVADA
  - *Las Vegas
  - *Reno
- 28-NEW JERSEY
  - Newark
- 29-NEW MEXICO
  - Albuquerque
- 30-NEW YORK
  - Albany
  - *Binghamton
  - Buffalo
  - New York
  - Rochester
  - Syracuse
- 31-NORTH CAROLINA
  - Charlotte
  - Greensboro
- 32-NORTH DAKOTA
  - Bismark
  - Fargo
- 33-OHIO
  - Akron
  - Cincinnati
  - Cleveland
  - Columbus
  - Dayton
  - Youngstown
- 34-OKLAHOMA
  - Oklahoma City
  - Tulsa
- 35-OREGON
  - Medford
  - Portland
  - *Salem
- 36-PENNSYLVANIA
  - Harrisburg
  - Philadelphia
  - *Pittsburgh
  - *Scranton
- 37-RHODE ISLAND
  - Providence
- 38-SOUTH CAROLINA
  - Charleston
  - Columbia
- 39-SOUTH DAKOTA
  - Huron
  - *Rapid City
- 40-TENNESSEE
  - Chattanooga
  - Knoxville
  - Memphis
  - Nashville
- 41-TEXAS
  - Amarillo
  - Austin
  - Brownsville
  - Corpus Christi
  - Dallas
  - El Paso
  - *Fort Worth
  - Galveston
  - Houston
  - Laredo
  - *Midland
  - San Antonio
  - *Waco
  - *Wichita Falls
- 42-UTAH
  - Salt Lake City
- 43-VERMONT
  - Burlington
- 44-VIRGINIA
  - Norfolk
  - Richmond
  - *Roanoke
- 45-WASHINGTON
  - Spokane
- 46-WEST VIRGINIA
  - *Charleston
- 47-WISCONSIN
  - *Green Bay
  - Madison
  - Milwaukee
- 48-WYOMING
  - Casper
- 49-ALASKA
  - *Anchorage
  - *Fairbanks
- 50-DIST.OF COLUMBIA
  - Washington
- 5I-HAWAII AND PACIFIC ISLANDS
  - *Hilo
  - Honolulu
- 52-PUERTO RICO
  - San Juan

*observations only from 1956 to 1960

Table 3 Average Annual Precipitation Data: USA (1951-1960)
(in millimeters)

State	Station	P(mm)*	D	H	P/D	P/H	H/D
AL	Birmingham	1251	113	510	11.07	2.45	4.51
AL	Montgomery	1183	108	457	10.95	2.59	4.23
AZ	Phoenix	180	35	115	5.14	1.57	3.29
AZ	Tucson	275	50	173	5.50	1.59	3.46
AR	Little Rock	1272	98	504	12.98	2.52	5.14
CA	Bakersfield	143	33	130	4.33	1.10	3.94
CA	Burbank	351	37	198	9.49	1.77	5.35
CA	Fresno	271	43	225	6.30	1.20	5.23
CA	Los Angeles	290	34	176	8.53	1.65	5.18
CA	Oakland	448	61	335	7.34	1.34	5.49
CA	Sacramento	472	57	336	8.28	1.40	5.89
CA	San Diego	221	41	179	5.39	1.23	4.37
CA	San Francisco	496	62	368	8.00	1.35	5.94
CO	Denver	311	83	387	3.75	0.80	4.66
CT	Hartford	1088	131	752	8.31	1.45	5.74
DC	Washington	1055	114	570	9.25	1.85	5.00
FL	Jacksonville	1294	111	452	11.66	2.86	4.07
FL	Miami	1513	130	444	11.64	3.41	3.42
FL	Orlando	1415	122	442	11.60	3.20	3.62
FL	W. Palm Beach	1534	136	454	11.28	3.38	3.34
GA	Atlanta	1126	110	523	10.24	2.15	4.75
GA	Augusta	990	102	478	9.71	2.07	4.69
GA	Macon	1207	114	533	10.59	2.26	4.68
GA	Savannah	1246	107	467	11.64	2.67	4.36
ID	Boise	296	91	384	3.25	0.77	4.22
IL	Chicago	858	119	565	7.21	1.52	4.75
IL	Moline	833	105	515	7.93	1.62	4.90
IL	Springfield	847	114	500	7.43	1.69	4.39
IN	Evansville	1022	112	532	9.13	1.92	4.75
IN	Fort Wayne	940	131	622	7.18	1.51	4.75
IN	Indianapolis	994	125	623	7.95	1.60	4.98
IN	South Bend	899	142	655	6.33	1.37	4.61
IA	Des Moines	773	104	490	7.43	1.58	4.71
IA	Sioux City	624	94	426	6.64	1.46	4.53
KS	Topeka	787	95	426	8.28	1.85	4.48
KS	Wichita	711	84	359	8.46	1.98	4.27
KY	Lexington	1160	130	655	8.92	1.77	5.04
KY	Louisville	1027	119	585	8.63	1.76	4.92

* P = Precipitation D = Days H = Hours

Continued on next page

Table 3--Continued

State	Station	P(mm)	D	H	P/D	P/H	H/D
LA	Baton Rouge	1230	104	424	11.83	2.90	4.08
LA	Lake Charles	1344	97	401	13.86	3.35	4.13
LA	New Orleans	1587	111	459	14.30	3.46	4.14
MD	Baltimore	1082	117	617	9.25	1.75	5.27
MI	Grand Rapids	793	141	680	5.62	1.17	4.82
MI	Detroit	794	137	625	5.80	1.27	4.56
MN	Duluth	740	133	629	5.56	1.18	4.73
MN	Minneapolis	635	110	289	5.77	1.30	4.45
MS	Jackson	1166	107	468	10.90	2.49	4.37
MO	Kansas City	847	97	455	8.73	1.86	4.69
MO	St. Louis	814	105	475	7.75	1.71	4.52
MO	Springfield	940	105	489	8.95	1.92	4.66
MT	Great Falls	389	100	456	3.89	0.85	4.56
NE	Omaha	750	96	442	7.81	1.70	4.60
NV	Las Vegas	102	22	86	4.64	1.19	3.91
NV	Reno	178	48	203	3.71	0.88	4.23
NJ	Newark	1092	123	673	8.88	1.62	5.47
NM	Albuquerque	185	51	154	3.63	1.20	3.02
NY	Albany	981	135	703	7.27	1.40	5.21
NY	Binghamton	991	169	843	5.86	1.18	4.99
NY	Buffalo	966	163	862	5.93	1.12	5.29
NY	New York	1030	127	713	8.11	1.44	5.61
NY	Rochester	794	151	759	5.26	1.05	5.03
NY	Syracuse	966	170	923	5.68	1.05	5.43
NC	Charlotte	1055	111	544	9.50	1.94	4.90
NC	Greensboro	1073	117	578	9.17	1.86	4.94
ND	Bismarck	381	99	383	3.85	0.99	3.87
ND	Fargo	482	92	362	5.24	1.33	3.93
OH	Akron	927	152	713	6.10	1.30	4.69
OH	Cincinnati	983	129	603	7.62	1.63	4.67
OH	Cleveland	934	158	736	5.91	1.27	4.66
OH	Columbus	844	135	645	6.25	1.31	4.78
OH	Dayton	893	131	607	6.82	1.47	4.63
OH	Youngstown	985	159	761	6.19	1.29	4.79
OK	Oklahoma City	815	80	358	10.19	2.28	4.48
OK	Tulsa	884	91	414	9.71	2.14	4.55
OR	Medford	518	100	518	5.18	1.00	5.18
OR	Portland	1104	158	1014	6.99	1.09	6.42
OR	Salem	996	153	1006	6.51	0.99	6.58
PA	Harrisburg	923	124	662	7.44	1.39	5.34
PA	Philadelphia	1037	115	624	9.02	1.66	5.43
PA	Pittsburgh	941	157	785	5.99	1.20	5.00
PA	Scranton	915	142	659	6.44	1.39	4.64
RI	Providence	1169	128	731	9.13	1.60	5.71
SC	Charleston	1536	115	559	13.36	2.75	4.86
SC	Columbia	1203	110	556	10.94	2.16	5.05

Continued on next page

Table 3--Continued

State	Station	P(mm)	D	H	P/D	P/H	H/D
SD	Huron	443	90	376	4.92	1.18	4.18
SD	Rapid City	385	101	394	3.81	0.98	3.90
TN	Chattanooga	1248	116	635	10.76	1.97	5.47
TN	Knoxville	1128	126	623	8.95	1.81	4.94
TN	Memphis	1252	103	525	12.16	2.38	5.10
TN	Nashville	1176	118	557	9.97	2.11	4.72
TX	Amarillo	488	66	266	7.39	1.83	4.03
TX	Austin	759	79	346	9.61	2.19	4.38
TX	Brownsville	613	72	280	8.51	2.19	4.38
TX	Corpus Christi	725	74	294	9.80	2.47	3.97
TX	Dallas	709	73	333	9.71	2.13	4.56
TX	El Paso	203	44	142	4.61	1.43	3.23
TX	Fort Worth	709	83	363	8.54	1.95	4.37
TX	Galveston	867	88	338	9.85	2.57	3.84
TX	Houston	1133	98	413	11.56	2.74	4.21
TX	Laredo	420	72	301	5.83	1.40	4.18
TX	Midland	315	57	213	5.53	1.48	3.74
TX	San Antonio	653	77	318	8.48	2.05	4.13
TX	Waco	827	78	353	10.60	2.34	4.53
TX	Wichita Falls	646	73	315	8.85	2.05	4.32
UT	Salt Lake City	353	87	382	4.06	0.92	4.39
VT	Burlington	837	147	760	5.69	1.10	5.17
VA	Norfolk	1162	118	609	9.85	1.91	5.16
VA	Richmond	1153	113	590	10.20	1.95	5.22
VA	Roanoke	975	126	633	7.74	1.54	5.02
WA	Spokane	444	118	573	3.76	0.77	4.86
WV	Charleston	1060	152	786	6.97	1.35	5.17
WI	Green Bay	679	115	498	5.90	1.36	4.33
WI	Madison	804	114	526	7.05	1.53	4.61
WI	Milwaukee	781	121	567	6.45	1.38	4.69
WY	Casper	262	95	360	2.76	0.73	3.79
AK	Anchorage	384	109	579	3.52	0.66	5.31
AK	Fairbanks	227	97	411	2.34	0.55	4.24
ME	Portland	110	131	795	0.84	0.14	6.07

Table 4 Number of Hours per Year with Indicated Precipitation

Station	from .25 to .50	.51 2.53	2.54 6.34	6.35 12.69	12.70 25.39	25.4 50.8	>50.8
	Millimeters per Day						
Birmingham	126	234	98	32	16	4	0
Montgomery	114	209	83	30	16	4	1
Phoenix	39	56	16	3	1	0	0
Tucson	58	81	23	5	2	4	0
Little Rock	123	236	96	32	16	1	0
Bakersfield	42	71	14	3	0	0	0
Burbank	54	92	35	14	3	0	0
Fresno	70	121	30	4	0	0	0
Los Angeles	54	85	24	11	2	0	0
Oakland	95	185	47	7	1	0	0
Sacramento	100	180	48	7	1	0	0
San Diego	62	87	23	6	1	0	0
San Francisco	121	184	52	10	1	0	0
Denver	152	195	31	6	2	1	0
Hartford	213	418	95	21	4	1	0
Washington	150	300	82	25	9	3	1
Jacksonville	117	197	80	32	17	8	1
Miami	101	191	78	37	24	8	5
Orlando	91	205	86	35	19	5	1
W. Palm Beach	85	210	89	41	21	7	1
Atlanta	131	250	95	28	13	5	1
Augusta	123	236	78	26	11	3	1
Macon	136	257	92	31	11	3	1
Savannah	118	212	81	34	14	7	1
Boise	154	208	19	2	1	0	1
Chicago	199	271	65	20	6	3	1
Moline	161	255	67	22	7	3	0
Springfield	162	243	64	20	7	3	1
Evansville	128	278	90	25	9	2	0
Fort Wayne	206	314	73	21	7	1	0
Indianapolis	204	295	86	23	11	4	0
South Bend	247	321	65	16	4	2	0
Des Moines	162	241	57	19	8	3	0
Sioux City	143	217	46	14	4	2	0
Topeka	127	206	59	22	10	2	0
Wichita	115	160	51	19	12	2	0
Lexington	180	345	93	24	11	2	0
Louisville	157	306	89	23	8	2	0
Baton Rouge	86	200	83	33	16	6	0
Lake Charles	81	179	76	36	20	8	1

Continued on next page

Table 4--Continued

Station	from .25 to .50	.51 2.53	2.54 6.34	6.35 12.69	12.70 25.39	25.4 50.8	>50.8
	Millimeters per Day						
New Orleans	105	204	82	38	21	7	2
Baltimore	171	322	91	22	8	3	0
Grand Rapids	280	314	58	18	8	2	0
Detroit	221	313	65	20	5	1	0
Duluth	256	298	54	15	5	1	0
Minneapolis	193	228	46	16	5	1	0
Jackson	111	217	83	36	16	5	0
Kansas City	120	232	69	22	10	2	0
St. Louis	142	239	65	19	8	2	0
Springfield	141	237	73	23	12	2	1
Great Falls	203	218	29	5	1	0	0
Omaha	138	212	50	18	13	11	0
Las Vegas	32	44	7	2	1	0	0
Reno	81	106	15	1	0	0	0
Newark	183	356	102	23	8	1	0
Albuquerque	51	81	17	4	1	0	0
Albany	214	390	76	16	6	1	0
Binghamton	312	439	73	13	5	1	0
Buffalo	311	448	81	17	4	1	0
New York	210	358	104	30	10	1	0
Rochester	305	374	60	16	4	0	0
Syracuse	376	452	71	17	6	1	0
Charlotte	137	274	95	26	9	3	0
Greensboro	171	279	84	30	11	3	0
Bismarck	184	162	26	7	3	1	0
Fargo	153	158	34	10	5	2	0
Akron	261	353	71	20	6	2	0
Cincinnati	185	303	83	21	9	2	0
Cleveland	257	381	71	19	6	2	0
Columbus	222	327	68	20	7	1	0
Dayton	189	316	72	19	9	2	0
Youngstown	271	385	75	21	7	2	0
Oklahoma City	105	158	54	24	13	4	0
Tulsa	111	200	62	24	13	4	0
Medford	183	282	49	3	1	0	0
Portland	370	559	79	6	0	0	0
Salem	329	594	79	6	0	0	0
Harrisburg	204	347	87	20	4	0	0
Philadelphia	170	327	92	26	7	0	0
Pittsburgh	303	384	75	17	5	1	0
Scranton	215	347	75	17	5	1	0
Providence	229	363	104	30	4	1	0
Charleston	135	260	95	45	17	6	1

Continued on next page

Table 4--Continued

Station	from .25 to .50	.51 2.53	2.54 6.34	6.35 12.69	12.70 25.39	25.4 50.8	>50.8
			Millimeters per Day				
Columbia	136	284	92	25	15	4	0
Huron	160	171	30	9	4	1	1
Rapid City	171	191	25	5	1	1	0
Chattanooga	177	302	109	32	13	2	0
Knoxville	144	333	108	28	8	2	0
Memphis	134	234	100	35	18	4	0
Nashville	128	281	101	31	11	5	0
Amarillo	81	123	38	14	7	2	1
Austin	112	148	49	22	11	3	1
Brownsville	92	120	35	18	9	5	1
Corpus Christi	89	118	40	21	13	10	3
Dallas	88	151	58	22	10	3	1
El Paso	44	67	21	7	2	1	0
Fort Worth	101	170	63	18	8	3	0
Galveston	91	151	57	25	11	3	0
Houston	113	183	69	26	16	5	1
Laredo	121	135	27	10	6	2	0
Midland	73	103	20	8	8	1	0
San Antonio	115	129	45	15	9	4	1
Waco	101	159	56	25	9	3	0
Wichita Falls	83	155	48	18	9	2	0
Salt Lake City	153	193	27	7	2	0	0
Burlington	286	390	27	7	2	0	0
Norfolk	163	307	91	32	11	5	0
Richmond	157	303	86	28	10	4	2
Roanoke	175	348	83	18	6	2	1
Spokane	218	327	25	3	0	0	0
Charleston	249	423	86	21	5	2	0
Green Bay	190	232	55	15	5	1	0
Madison	189	248	62	18	7	2	0
Milwaukee	200	280	59	20	5	3	0
Casper	162	174	21	2	1	0	0

Table 5 Number of Days per Year with Indicated Precipitation

Station	Millimeters per Day: from .25 to .50	.51 2.53	2.54 6.34	6.35 12.69	12.70 25.39	25.4 50.8	>50.8
Birmingham	10	27	20	21	21	12	2
Montgomery	10	28	21	18	17	11	3
Phoenix	7	11	7	5	3	1	1
Tucson	8	17	12	8	4	1	0
Little Rock	6	26	18	15	17	12	4
Bakersfield	3	15	8	4	3	0	0
Burbank	6	10	6	6	5	1	1
Fresno	5	12	10	8	6	1	1
Los Angeles	4	10	7	6	5	1	1
Oakland	5	20	13	11	9	3	0
Sacramento	7	16	12	11	8	3	0
San Diego	6	14	10	6	4	1	0
San Francisco	7	18	14	9	9	5	0
Denver	12	35	18	11	5	2	0
Hartford	7	43	30	24	18	8	1
Washington	12	30	25	21	17	7	2
Jacksonville	9	29	20	19	19	12	3
Miami	10	40	26	20	17	12	5
Orlando	9	31	26	20	20	12	4
W. Palm Beach	7	41	28	26	18	12	4
Atlanta	8	27	24	20	19	10	2
Augusta	6	27	22	19	19	7	2
Macon	8	30	24	21	18	9	4
Savannah	8	26	21	20	18	11	3
Boise	13	41	23	11	3	0	0
Chicago	14	37	28	19	14	5	2
Moline	10	35	21	18	14	6	1
Springfield	14	37	24	17	15	6	1
Evansville	11	30	24	18	20	7	2
Fort Wayne	14	42	28	22	18	6	1
Indianapolis	12	36	30	22	17	7	1
South Bend	17	51	32	23	13	5	1
Des Moines	12	36	20	18	12	5	1
Sioux City	12	31	21	15	11	3	1
Topeka	9	27	21	17	14	6	1
Wichita	9	28	18	11	11	5	2
Lexington	12	39	24	26	17	10	2
Louisville	11	32	26	22	19	8	1
Baton Rouge	7	24	23	18	19	10	3
Lake Charles	8	22	19	16	15	12	5

Continued on next page

Table 5--Continued

Station	from .25 to .50	.51 2.53	2.54 6.34	6.35 12.69	12.70 25.39	25.4 50.8	>50.8
	Millimeters per Day						
New Orleans	11	28	19	18	18	12	5
Baltimore	11	33	22	22	18	8	3
Grand Rapids	18	52	31	23	12	4	1
Detroit	22	45	31	20	14	4	1
Duluth	21	49	31	15	12	4	1
Minneapolis	16	39	23	17	10	4	1
Jackson	10	27	19	19	18	11	3
Kansas City	9	28	20	16	16	7	1
St. Louis	9	32	24	19	14	6	1
Springfield	10	30	19	19	16	9	2
Great Falls	17	40	25	11	6	1	0
Omaha	11	32	18	16	11	7	1
Las Vegas	4	8	6	2	2	0	0
Reno	6	21	11	6	2	1	1
Newark	12	33	27	21	20	9	1
Albuquerque	6	24	12	6	3	0	0
Albany	14	44	31	24	15	6	1
Binghamton	19	61	42	28	15	4	1
Buffalo	15	57	40	28	18	4	1
New York	14	34	25	23	19	10	2
Rochester	17	59	33	24	15	3	0
Syracuse	19	61	42	28	15	4	1
Charlotte	8	28	24	21	19	9	2
Greensboro	11	31	25	21	18	9	2
Bismarck	17	46	18	10	6	2	0
Fargo	14	39	17	11	7	3	1
Akron	18	53	33	25	17	5	1
Cincinnati	13	41	27	21	19	7	1
Cleveland	18	58	34	27	15	6	0
Columbus	16	40	32	23	19	4	1
Dayton	15	41	31	22	16	5	1
Youngstown	17	55	36	28	17	5	1
Oklahoma City	9	23	15	11	13	7	2
Tulsa	9	27	17	13	14	9	2
Medford	12	39	24	14	8	3	0
Portland	15	48	41	32	17	5	0
Salem	11	47	44	30	15	6	0
Harrisburg	13	38	26	24	16	6	1
Philadelphia	10	32	25	19	20	8	1
Pittsburgh	14	59	39	21	18	5	1
Scranton	16	47	33	22	18	5	1
Providence	14	38	25	21	18	10	2
Charleston	6	21	25	24	21	12	6

Continued on next page

Table 5--Continued

Station	from .25 to .50	.51 2.53	2.54 6.34	6.35 12.69	12.70 25.39	25.4 50.8	>50.8
	Millimeters per Day						
Columbia	8	28	20	22	19	10	3
Huron	13	41	16	11	7	2	0
Rapid City	14	46	20	12	5	2	2
Chattanooga	8	29	23	22	21	10	3
Knoxville	9	35	26	24	22	9	1
Memphis	7	23	19	17	21	13	3
Nashville	9	30	25	22	20	10	2
Amarillo	9	22	15	9	7	3	1
Austin	10	24	16	10	10	7	2
Brownsville	12	26	12	8	7	5	2
Corpus Christi	12	25	13	9	7	5	3
Dallas	6	19	15	13	11	7	2
El Paso	6	18	10	6	3	1	0
Fort Worth	10	23	16	15	11	6	2
Galveston	9	24	18	15	13	7	2
Houston	10	29	19	15	13	8	4
Laredo	14	27	14	5	6	5	1
Midland	7	19	15	7	4	5	0
San Antonio	11	25	16	9	9	5	2
Waco	8	23	14	13	11	7	2
Wichita Falls	4	22	16	12	10	7	2
Salt Lake City	13	36	18	13	5	1	1
Burlington	17	53	33	26	13	4	1
Norfolk	11	33	23	20	17	11	3
Richmond	9	31	24	19	19	8	3
Roanoke	12	39	27	25	15	7	1
Spokane	15	45	34	17	6	1	0
Charleston	16	48	34	26	21	6	1
Green Bay	15	43	27	15	11	3	1
Madison	13	38	25	18	13	6	1
Milwaukee	15	40	28	20	13	4	1
Casper	13	47	22	9	4	0	0
Anchorage	18	49	26	12	3	1	0
Fairbanks	19	52	16	8	2	0	0
Portland ME	11	42	26	21	22	8	1

Table 6. Cumulative Percent Frequencies of Hourly Precipitation per P/H

Station		P(MM)*	H	P/H	Millimeters per Hour ≤0.51	≤2.54	≤6.35	≤12.70	≤25.40	≤50.80	T(C)
A.	Casper	262	360	0.73	45.0	93.3	99.2	99.7	100.0	100.0	7.3
	Boise	296	384	0.77	40.1	94.3	99.2	99.7	100.0	100.0	10.4
	Spokane	444	573	0.77	38.0	95.1	99.5	100.0	100.0	100.0	8.5
	Denver	311	387	0.80	39.3	89.7	97.7	99.2	99.7	100.0	11.3
	Great Falls	389	456	0.85	44.5	92.3	98.7	99.8	100.0	100.0	7.3
	Reno	178	203	0.88	39.9	92.1	99.5	100.0	100.0	100.0	9.9
	Salt Lake City	353	332	0.92	40.1	90.6	97.6	99.5	100.0	100.0	10.9
	Rapid City	385	394	0.98	43.4	91.9	98.2	99.5	99.7	100.0	8.4
	Bismark (?ck)	381	383	0.99	48.0	90.3	97.1	99.0	99.7	100.0	5.4
B.	Medford	518	518	1.00	35.3	89.8	99.2	99.8	100.0	100.0	12.1
	Rochester	794	759	1.05	40.2	89.5	97.4	99.5	100.0	100.0	8.8
	Syracuse	966	923	1.05	40.7	89.7	97.4	99.2	99.9	100.0	8.7
	Portland	1104	1014	1.09	36.5	91.6	99.4	100.0	100.0	100.0	12.4
	Bakersfield	143	130	1.10	32.3	86.9	97.7	100.0	100.0	100.0	18.0
	Burlington	837	760	1.10	37.6	88.9	97.5	99.5	99.9	100.0	6.9
	Buffalo	966	862	1.12	36.1	88.1	97.4	99.4	99.9	100.0	8.5
	Grand Rapids	793	680	1.17	41.2	87.4	95.9	98.5	99.7	100.0	9.1
	Binghamton	991	843	1.18	37.0	89.1	97.7	99.3	99.9	100.0	7.6
	Duluth	740	629	1.18	40.7	88.1	96.7	99.0	99.8	100.0	3.6
	Huron	443	376	1.18	42.6	88.0	96.0	98.4	99.5	99.7	7.1
	Las Vegas	102	86	1.19	37.2	88.4	96.5	98.8	100.0	100.0	18.9

Continued on next page

*P = Precipitation; MM = Millimeters; H = Hours; T(C) = Mean Annual Temperature in Degrees Celsius

Table 6--Continued

Station		P(MM)	H	P/H	Millimeters per Hour ≤0.51	≤2.54	≤6.35	≤12.70	≤25.40	≤50.80	T(C)
C.	Fresno	271	225	1.20	31.1	84.9	98.2	100.0	100.0	100.0	17.2
	Albuquerque	185	154	1.20	33.1	85.7	96.8	99.4	100.0	100.0	14.2
	Pittsburgh	941	785	1.20	38.6	87.5	97.1	99.2	99.9	100.0	12.3
	San Diego	221	179	1.23	34.6	83.2	96.1	99.4	100.0	100.0	17.6
	Detroit	794	625	1.27	35.4	85.4	95.8	99.0	99.8	100.0	9.5
	Cleveland	934	736	1.27	34.9	86.7	96.3	98.9	99.7	100.0	9.9
	Youngstown	985	761	1.29	35.6	86.2	96.1	98.8	99.7	100.0	9.2
	Minneapolis	635	489	1.30	39.5	86.1	95.5	98.8	99.8	100.0	7.4
	Akron	927	713	1.30	36.6	86.1	96.1	98.9	99.7	100.0	9.8
	Columbus	844	645	1.31	34.4	85.1	95.7	93.8	99.8	100.0	12.2
	Fargo	482	362	1.33	42.3	85.9	95.3	98.1	99.4	100.0	4.6
	Oakland	448	335	1.34	28.4	83.6	97.6	99.7	100.0	100.0	14.1
	San Francisco	496	368	1.35	32.9	82.9	97.0	99.7	100.0	100.0	13.8
	Charleston	1060	786	1.35	31.7	85.5	96.4	99.1	99.7	100.0	13.4
	Green Bay	679	498	1.36	38.2	84.7	95.8	98.8	99.8	100.0	6.7
	South Bend	899	655	1.37	37.7	86.7	96.6	99.1	99.7	100.0	9.7
	Milwaukee	781	567	1.38	35.3	84.7	95.1	98.6	99.5	100.0	8.1
	Harrisburg	923	662	1.39	30.8	83.2	96.4	99.4	100.0	100.0	11.5
	Scranton	915	659	1.39	32.6	85.3	96.7	99.4	99.8	100.0	9.7
D.	Sacramento	472	336	1.40	29.8	83.3	97.6	99.7	100.0	100.0	16.3
	Albany	981	703	1.40	30.4	85.9	96.7	99.0	99.9	100.0	10.1
	Laredo	420	301	1.40	40.2	85.0	94.0	97.3	99.3	100.0	23.3
	El Paso	203	142	1.43	31.0	78.2	93.0	97.9	99.3	100.0	18.0
	New York	1030	713	1.44	29.5	79.7	94.2	98.5	99.9	100.0	12.7
	Hartford	1088	752	1.45	28.3	83.9	96.5	99.3	99.9	100.0	10.0
	Sioux City	624	426	1.46	33.6	84.5	95.3	98.8	99.5	100.0	9.3
	Dayton	893	607	1.47	31.1	83.2	95.1	98.2	99.7	100.0	11.3
	Midland	315	213	1.48	34.3	82.6	92.0	95.8	99.5	100.0	17.8
	Fort Wayne	940	622	1.51	33.1	83.6	95.3	98.7	99.8	100.0	10.0
	Chicago	858	565	1.52	35.2	83.2	94.7	98.2	99.3	99.8	10.7
	Madison	804	526	1.53	35.9	83.1	94.9	98.3	99.6	100.0	8.0
	Roanoke	975	633	1.54	27.6	82.6	95.7	98.6	99.5	99.8	13.4
	Phoenix	180	115	1.57	33.9	82.6	96.5	99.1	100.0	100.0	21.6
	Des Moines	773	490	1.58	33.1	82.2	93.9	97.8	99.4	100.0	10.4
	Tucson	275	173	1.59	33.5	80.3	93.6	96.5	97.7	100.0	20.3

Continued on next page

Table 6--Continued

Station		P(MM)	H	P/H	Millimeters per Hour ≤0.51	≤2.54	≤6.35	≤12.70	≤25.40	≤50.80	T(C)
E.	Indianapolis	994	623	1.60	32.7	80.1	93.9	97.6	99.4	100.0	11.4
	Providence	1169	731	1.60	31.3	81.0	95.2	99.3	99.9	100.0	10.1
	Moline	833	515	1.62	31.3	80.8	93.8	98.1	99.4	100.0	9.9
	Newark	1092	673	1.62	27.2	80.1	95.2	98.7	99.9	100.0	12.1
	Cincinnati	983	603	1.63	30.7	80.9	94.7	98.2	99.7	100.0	12.0
	Los Angeles	290	176	1.65	30.7	79.0	92.6	98.9	100.0	100.0	17.1
	Philadelphia	1037	624	1.66	27.2	79.6	94.4	98.6	99.7	100.0	12.8
	Springfield	847	500	1.69	32.4	81.0	93.8	97.8	99.2	99.8	11.8
	Omaha	750	442	1.70	31.2	79.2	90.5	94.6	97.5	100.0	10.7
	St. Louis	814	475	1.71	29.9	80.2	93.9	97.9	99.6	100.0	13.6
	Baltimore	1082	617	1.75	27.7	79.9	94.7	98.2	99.5	100.0	12.8
	Louisville	1027	585	1.76	26.8	79.1	94.4	98.3	99.7	100.0	13.8
	Burbank	351	198	1.77	27.3	73.7	91.4	98.5	100.0	100.0	17.3
	Lexington	1160	355	1.77	27.5	80.2	94.4	98.0	99.7	100.0	12.1
F.	Knoxville	1128	623	1.81	23.1	76.6	93.9	98.4	99.7	100.0	14.9
	Amarillo	488	266	1.83	30.5	76.7	91.0	96.2	98.9	99.6	13.9
	Washington	1055	570	1.85	25.9	69.5	87.2	94.2	98.0	99.8	14.2
	Topeka	787	426	1.85	29.8	78.2	92.0	97.2	99.5	100.0	12.6
	Kansas City	847	455	1.86	26.4	77.4	92.5	97.4	99.6	100.0	13.0
	Greensboro	1073	578	1.86	29.6	77.9	92.4	97.6	99.5	100.0	14.4
	Norfolk	1162	609	1.91	26.8	77.2	92.1	97.4	99.2	100.0	15.4
	Evansville	1022	532	1.92	24.1	76.3	93.2	97.9	99.6	100.0	13.7
	Springfield	940	489	1.92	28.8	77.3	92.2	96.9	99.4	99.8	13.3
	Charlotte	1055	544	1.94	25.2	75.6	93.0	97.8	99.4	100.0	15.8
	Fort Worth	709	363	1.95	27.8	74.7	92.0	97.0	99.2	100.0	18.7
	Richmond	1153	590	1.95	26.6	78.0	92.5	97.3	99.0	99.7	14.3
	Chattanooga	1248	635	1.97	27.9	75.4	92.6	97.6	99.7	100.0	15.7
	Wichita	711	359	1.98	32.0	76.6	add	add	add	add	add

Continued on next page

Table 6--Continued

Station		P(MM)	H	P/H	*Millimeters per Hour* ≤0.51	≤2.54	≤6.35	≤12.70	≤25.40	≤50.80	T(C)
G.	San Antonio	653	318	2.05	36.2	76.7	90.9	95.6	98.4	99.7	20.6
	Wichita Falls	646	315	2.05	26.3	75.6	90.8	96.5	99.4	100.0	17.9
	Augusta	990	478	2.07	25.7	75.1	91.4	96.9	99.2	99.8	18.0
	Nashville	1176	557	2.11	23.0	73.4	91.6	97.1	99.1	100.0	15.5
	Dallas	709	333	2.13	26.4	71.8	89.2	95.8	98.8	99.7	18.7
	Tulsa	884	414	2.14	26.8	75.1	90.1	95.9	99.0	100.0	15.9
	Atlanta	1126	523	2.15	25.0	72.8	91.0	96.4	98.9	99.8	16.3
	Columbia	1203	556	2.16	24.5	75.5	92.1	96.6	99.3	100.0	17.3
	Austin	759	346	2.19	32.4	75.1	89.3	95.7	98.8	99.7	20.0
	Brownsville	613	280	2.19	32.9	75.7	88.2	94.6	97.9	99.6	23.3
	Macon	1207	533	2.26	25.9	74.1	91.4	97.2	99.2	99.8	18.5
	Oklahoma City	815	358	2.28	29.3	73.5	88.5	95.3	98.9	100.0	15.5
	Waco	827	353	2.34	28.6	73.7	89.5	96.6	99.2	100.0	19.6
	Memphis	1252	525	2.38	25.5	70.1	89.1	95.8	99.2	100.0	16.8
	Birmingham	1251	510	2.45	24.7	70.6	89.8	96.1	99.2	100.0	17.2
	Jackson	1166	468	2.49	23.7	70.1	87.8	95.5	98.9	100.0	18.6
H.	Little Rock	1272	504	2.52	24.4	71.2	90.3	96.6	99.8	100.0	17.0
	Galveston	867	338	2.57	26.9	71.6	88.5	95.9	99.1	100.0	21.1
	Montgomery	1183	457	2.59	24.9	70.7	88.8	95.4	98.9	99.8	18.3
	Savannah	1246	467	2.67	25.3	70.7	88.0	95.3	98.3	99.8	19.3
	Houston	1133	413	2.74	27.4	71.7	88.4	94.7	98.5	99.8	19.9
	Charleston	1536	559	2.75	24.2	70.7	87.7	95.7	98.7	99.8	17.9
	Jacksonville	1294	452	2.86	25.9	69.5	87.2	94.2	98.0	99.8	20.9
	Baton Rouge	1230	424	2.90	20.3	67.5	87.0	94.8	98.6	100.0	19.7
I.	Orlando	1415	442	3.20	20.6	67.0	86.4	94.3	98.6	99.8	22.4
	Lake Charles	1344	401	3.35	20.2	64.8	83.8	92.8	97.8	99.8	20.1
	W. Palm Beach	1534	454	3.38	18.7	65.0	84.6	93.6	98.2	99.8	23.8
	Miami	1513	444	3.41	22.7	65.8	83.3	91.7	97.1	98.9	24.1
	New Orleans	1587	459	3.46	22.9	67.3	85.2	93.5	98.0	99.6	21.3

Table 7. Cumulative Percent Frequencies of Daily Precipitation per P/D

Station		P(MM) *	D	P/D	Millimeters per Hour						T(C)
					≤0.51	≤2.54	≤6.35	≤12.70	≤25.40	≤50.80	
A.	Boise	296	90	3.29	14.3	59.3	84.6	96.7	100.0	100.0	10.4
	Albuquerque	185	52	3.56	11.8	58.8	82.4	94.1	100.0	100.0	14.2
	Reno	178	48	3.71	12.5	56.3	79.2	91.7	95.8	97.9	9.9
	Denver	311	83	3.75	14.5	56.6	78.3	91.6	97.6	100.0	11.3
	Spokane	444	118	3.76	12.7	50.8	79.7	94.1	99.2	100.0	8.5
	Rapid City	385	101	3.81	13.9	59.4	79.2	91.1	96.0	98.0	8.4
	Bismark (?)	381	99	3.85	17.2	63.6	81.8	91.9	98.0	100.0	5.4
	Great Falls	389	100	3.89	17.0	57.0	82.0	93.0	99.0	100.0	7.3
B.	Salt Lake City	353	87	4.06	14.9	56.3	77.0	92.0	97.7	98.9	10.9
	Bakersfield	143	33	4.33	9.1	54.5	78.8	90.9	100.0	100.0	18.0
	El Paso	203	44	4.61	13.6	54.5	77.3	90.9	97.7	100.0	18.00
	Las Vegas	102	22	4.64	18.2	54.5	81.8	90.9	100.0	100.0	18.9
	Huron	443	90	4.92	14.4	60.0	77.8	90.0	97.8	100.0	7.1
C.	Phoenix	180	35	5.14	20.0	51.4	71.4	85.7	94.3	97.1	21.6
	Medford	518	100	5.18	12.0	51.0	75.0	89.0	97.0	100.0	12.1
	Fargo	482	92	5.24	15.2	57.6	76.1	88.0	95.7	98.9	4.6
	Rochester	794	151	5.26	11.3	50.3	72.2	88.1	98.0	100.0	8.8
	San Diego	221	41	5.39	14.6	48.8	73.2	87.8	97.6	100.0	17.6
	Tucson	275	50	5.50	16.0	50.0	74.0	90.0	98.0	100.0	20.3
	Midland	315	57	5.53	12.3	45.6	71.9	84.2	91.2	100.0	17.8
	Duluth	740	133	5.56	15.8	52.6	75.9	87.2	96.0	99.2	3.6
D.	Grand Rapids	793	141	5.62	12.8	49.6	71.6	87.9	96.5	99.3	9.1
	Syracuse	966	170	5.68	11.2	47.1	71.8	88.2	97.2	99.4	8.7
	Burlington	837	147	5.69	11.6	47.6	70.1	87.8	96.6	99.3	6.9
	Minneapolis	635	110	5.77	14.5	50.0	70.9	86.4	95.5	99.1	7.4
	Detroit	794	137	5.80	16.1	48.9	71.5	86.1	96.4	99.3	9.5
	Laredo	420	72	5.83	19.4	56.9	76.4	83.3	91.7	98.6	23.3
	Binghamton	991	169	5.86	11.2	47.3	71.6	85.2	96.4	99.4	7.6
	Green Bay	679	115	5.90	13.0	50.4	73.9	87.0	96.5	99.1	6.7
	Cleveland	934	158	5 91	11.4	48.1	69.0	86.7	96.2	100.0	9.9
	Buffalo	966	163	5.93	9.2	44.2	68.7	85.9	96.9	99.4	8.5
	Pittsburgh	941	157	5.99	8.9	46.5	71.3	84.7	96.2	99.4	12.3

* P = Precipitation; MM = Millimeters; D = Days; T(C) = Mean Annual Temperature in Degrees Celsius

Continued on next page

Table 7--Continued

Station		P(MM)	D	P/D	≤0.51	≤2.54	≤6.35	≤12.70	≤25.40	≤50.80	T(C)
					Millimeters per Hour						
E.	Akron	927	152	6.10	11.8	46.7	68.4	84.9	96.1	99.3	9.8
	Youngstown	985	159	6.19	10.7	45.3	67.9	85.5	96.2	99.4	9.2
	Columbus	844	135	6.25	11.9	41.5	65.2	82.2	96.3	99.3	12.2
	Fresno	271	43	6.30	11.6	39.5	62.8	81.4	95.3	97.7	17.2
	South Bend	899	142	6.33	12.0	47.9	70.4	86.6	95.8	99.3	9.7
	Milwaukee	781	121	6.45	12.4	45.5	68.6	85.1	95.9	99.2	8.1
	Scranton	915	142	6.44	11.3	44.7	68.1	83.7	96.5	100.0	9.7
	Salem	996	153	6.51	7.2	37.9	66.7	86.3	96.1	100.0	11.3
	Sioux City	624	94	6.64	12.8	45.7	68.1	84.0	95.7	98.9	9.1
	Dayton	893	131	6.82	11.5	42.7	66.4	83.2	95.4	99.2	11.3
	Charleston	1060	152	6.97	10.5	42.1	64.5	81.6	95.4	99.3	13.4
	Portland	1104	158	6.99	9.3	39.9	65.8	36.1	96.8	100.0	12.4
F.	Madison	804	114	7.05	11.4	44.7	66.7	82.5	93.9	99.1	8.0
	Fort Wayne	940	131	7.18	10.7	42.7	64.1	80.9	94.7	99.2	10.0
	Chicago	858	119	7.21	11.8	42.9	66.4	82.4	94.1	98.3	10.9
	Albany	981	134	7.32	10.4	43.0	65.9	83.7	94.8	99.3	10.1
	Oakland	448	61	7.34	8.2	41.0	62.3	80.3	95.1	100.0	14.1
	Amarillo	488	66	7.39	13.6	47.0	69.7	83.3	93.9	98.5	13.9
	Springfield	847	114	7.43	12.3	44.7	65.8	80.7	93.9	99.1	11.8
	Des Moines	773	104	7.43	11.5	46.2	65.4	82.7	94.2	99.0	10.4
	Harrisburg	923	124	7.44	10.5	41.1	62.1	81.5	94.4	99.2	11.5
	Cincinnati	983	129	7.62	10.1	41.9	62.8	79.1	93.8	99.2	12.0
	Roanoke	975	126	7.74	9.5	40.5	61.9	81.7	93.7	99.2	13.4
	St. Louis	814	105	7.75	8.6	39.0	61.9	80.0	93.3	99.0	13.6
	Omaha	750	96	7.81	11.5	44.8	63.5	80.2	91.7	99.0	10.7
	San Francisco	491	62	7.92	11.3	40.3	62.9	77.4	91.9	100.0	13.8
	Moline	833	105	7.93	9.5	42.9	62.9	80.0	93.3	99.0	9.9
	Indianapolis	994	125	7.95	9.6	38.4	62.4	80.0	93.6	99.2	11.4

Continued on next page

Table 7--Continued

Station	P(MM)	D	P/D	Millimeters per Hour ≤0.51	≤2.54	≤6.35	≤12.70	≤25.40	≤50.80	T(C)
G. New York	1030	127	8.11	11.0	37.8	57.5	75.6	90.6	98.4	12.7
Hartford	1088	131	8.31	5.3	38.2	61.1	79.4	93.1	99.2	10.0
Sacramento	472	57	8.28	12.3	40.4	61.4	80.7	94.7	100.0	16.4
Topeka	787	95	8.28	9.5	37.9	60.0	77.9	92.6	98.9	12.6
Portland	1098	131	8.38	8.4	40.5	60.3	76.3	93.1	99.2	7.4
Wichita	711	84	8.46	10.7	44.0	65.5	78.6	91.7	97.6	13.7
San Antonio	653	77	8.48	14.3	46.8	67.5	79.2	90.9	97.4	20.6
Brownsville	613	72	8.51	16.7	52.8	69.4	80.6	90.3	97.2	23.3
Los Angeles	290	34	8.53	11.8	41.2	61.8	79.4	94.1	97.1	17.1
Fort Worth	709	83	8.54	12.0	39.8	59.0	77.1	90.4	97.6	18.7
Louisville	1027	119	8.63	9.2	36.1	58.0	76.5	92.4	99.2	13.8
Kansas City	847	97	8.73	9.3	38.1	58.8	75.3	91.8	99.0	13.0
Wichita Falls	646	73	8.85	5.5	35.6	57.5	74.0	87.7	97.3	17.9
Newark	1092	122	8.95	9.8	36.6	58.5	75.6	91.9	99.2	12.1
Lexington	1160	130	8.92	9.2	39.2	57.7	77.7	90.8	98.5	12.1
Springfield	940	105	8.95	9.5	38.1	56.2	74.3	89.5	98.1	13.3
Knoxville	1128	126	8.95	7.1	34.9	55.6	74.6	92.1	99.2	14.9
H. Philadelphia	1037	115	9.02	8.7	36.5	58.3	74.8	92.2	99.1	12.8
Evansville	1022	112	9.13	9.8	36.6	58.8	74.1	92.0	98.2	13.7
Providence	1169	128	9.13	10.9	40.6	60.2	76.6	90.6	98.4	10.3
Greensboro	1073	117	9.17	9.4	35.9	57.3	75.2	90.6	98.3	11.7
Baltimore	1082	117	9.25	9.4	37.6	56.4	75.2	90.6	97.4	12.8
Washington DC	1055	114	9.25	10.5	36.8	58.8	77.2	92.1	98.2	14.2
Burbank	351	37	9.49	16.2	43.2	59.5	75.7	89.2	97.3	17.2
Charlotte	1055	111	9.50	7.2	32.4	54.1	73.0	90.1	98.2	15.8
Austin	759	79	9.61	12.7	43.0	63.3	75.9	88.6	97.5	20.0
Augusta	990	102	9.71	5.9	32.4	53.9	72.5	91.2	98.0	18.0
Tucson	884	91	9.71	9.9	39.6	58.2	72.5	87.9	97.8	15.9
Dallas	709	73	9.71	8.2	34.2	54.8	72.6	87.7	97.3	18.9
Galveston	867	88	9.85	10.2	37.5	58.0	75.0	89.8	97.7	21.1
Norfolk	1162	118	9.85	9.3	37.3	56.8	73.7	88.1	97.5	15.4
Nashville	1176	118	9.97	7.6	33.1	54.2	72.9	89.9	98.3	15.5

Continued on next page

Table 7--Continued

Station		P(MM)	D	P/D	Millimeters per Hour ≤0.51	≤2.54	≤6.35	≤12.70	≤25.40	≤50.80	T(C)
I.	Oklahoma City	815	80	10.19	11.3	40.0	58.8	72.5	88.8	97.5	15.5
	Richmond	1153	113	10.20	8.0	35.4	56.6	73.5	90.3	97.3	14.3
	Atlanta	1126	110	10.24	7.3	31.8	53.6	71.8	89.1	98.2	16.3
	Macon	1207	114	10.59	7.0	33.3	54.4	72.8	88.6	96.5	18.5
	Waco	827	78	10.60	10.3	39.7	57.7	74.4	88.5	97.4	19.6
	Chattanooga	1248	116	10.76	6.9	31.9	51.7	70.7	88.8	97.4	15.7
	Jackson	1166	107	10.90	9.3	34.6	52.3	70.1	86.9	97.2	18.6
	Columbia	1203	110	10.94	7.3	32.7	50.9	70.9	88.2	97.3	17.3
	Montgomery	1183	108	10.95	9.3	35.2	54.6	71.3	87.0	97.2	18.6
J.	Birmingham	1251	113	11.07	8.8	32.7	50.4	69.0	87.6	98.2	17.2
	W. Palm Beach	1534	136	11.28	5.1	35.3	55.9	75.0	88.2	97.1	23.8
	Houston	1133	98	11.56	10.2	39.8	59.2	74.5	87.8	95.9	19.9
	Orlando	1415	122	11.60	7.4	32.8	54.1	70.5	86.9	96.7	22.4
	Miami	1513	130	11.64	13.7	42.4	61.2	75.5	87.8	96.4	24.1
	Savannah	1246	107	11.64	7.5	31.8	51.4	70.1	86.9	97.2	19.3
	Jacksonville	1294	111	11.66	8.1	34.2	52.3	69.4	86.5	97.3	20.9
	Baton Rouge	1230	104	11.83	6.7	29.8	51.9	69.2	87.5	97.1	19.7
K.	Memphis	1252	103	12.16	6.8	29.1	47.6	64.1	84.5	97.1	16.8
	Little Rock	1272	98	12.98	6.1	32.7	51.0	66.3	83.7	95.9	17.0
	Charleston	1536	115	13.36	5.2	23.5	45.2	66.1	84.3	94.8	17.9
	Lake Charles	1344	97	13.86	8.2	30.9	50.5	67.0	82.5	94.8	20.1
	New Orleans	1587	111	14.30	9.9	35.1	52.3	68.5	84.7	95.5	21.3

Table 8. Averages and Mean Deviations of Precipitation Frequencies

Table 8a. Averages and Mean Deviations of Cumulative Percent Frequencies for Hourly Precipitation

Station Group*		P(MM)**	H	P/H	Millimeters per Hour ≤0.51	≤2.54	≤6.35	≤12.70	≤25.40	≤50.80	T(C)
A	AV	333.2	391.3	0.86	42.0	92.2	98.5	99.6	99.9	100.0	8.8
	MD	63.5	55.3	0.08	2.8	1.4	0.8	0.3	0.1	0.0	1.6
B	AV	699.8	631.7	1.12	38.1	88.8	97.4	99.3	99.9	100.0	10.1
	MD	265.5	236.6	0.05	2.5	1.0	0.7	0.4	0.1	0.0	3.5
C	AV	706.3	537.1	1.31	34.9	85.2	96.3	99.1	99.8	100.0	11.1
	MD	235.1	177.5	0.05	2.6	1.0	0.6	0.4	0.1	0.0	2.8
D	AV	676.9	457.3	1.49	32.5	82.7	94.9	98.2	99.5	100.0	14.0
	MD	281.2	186.9	0.05	2.5	1.4	1.2	0.7	0.3	0.1	4.2
E	AV	887.8	529.8	1.68	29.6	79.6	93.8	98.1	99.5	100.0	12.7
	MD	206.0	124.7	0.06	2.0	1.1	1.0	0.6	0.4	0.0	1.6
F	AV	955.6	502.8	1.90	27.5	76.2	92.0	97.1	99.3	99.9	14.5
	MD	178.8	94.1	0.05	2.0	1.4	1.0	0.7	0.3	0.1	1.1
G	AV	954.8	429.2	2.22	27.3	73.7	90.0	96.1	99.0	99.9	18.1
	MD	216.6	89.6	0.12	2.9	1.7	1.1	0.6	0.3	0.1	1.6
H	AV	1220.1	451.8	2.70	24.9	70.5	88.2	95.3	98.7	99.9	19.3
	MD	119.4	45.1	0.11	1.5	0.9	0.8	0.6	0.4	0.1	1.1
I	AV	1478.6	440.0	3.36	21.0	66.0	84.7	93.2	97.9	99.6	22.3
	MD	79.3	15.6	0.07	1.4	0.9	0.9	0.7	0.4	0.3	1.3

* Each set from A through I refers, respectively, to the corresponding group of stations, A through I, in table 5.

** P = Precipitation; MM = Millimeters; H = Hours; T(C) = Mean Annual Temperature in Degrees Celsius

AV = Average; MD = Mean deviation

Continued on next page

Table 8--Continued

Table 8b. Averages and Mean Deviations of Cumulative Percent Frequencies for Daily Precipitation

Station Group*		P(MM)**	D	P/D	Millimeters per Hour ≤0.51	≤2.54	≤6.35	≤12.70	≤25.40	≤50.80	T(C)
A	AV	321.1	86.4	3.70	14.2	57.7	80.9	93.0	98.2	99.5	9.4
	MD	78.6	19.0	0.14	1.5	2.6	1.8	1.4	1.3	0.8	2.0
B	AV	248.8	55.2	4.51	14.0	56.0	78.5	90.9	98.6	99.8	14.6
	MD	119.4	26.6	0.25	2.2	1.8	1.4	0.4	1.1	0.3	4 5
C	AV	440.6	82.4	5.35	14.7	50.9	73.7	87.5	96.0	99.4	13.3
	MD	192.9	36.6	0.15	2.1	2.2	1.5	1.4	1.7	0.8	6.0
D	AV	814.2	139.9	5.82	12.7	48.8	71.5	86.3	96.0	99.3	10.0
	MD	136.3	22.8	0.09	2.3	2.2	1.4	1.1	0.9	0.2	2.8
E	AV	858.3	131.8	6.50	11.1	43.3	66.9	84.2	96.0	99.3	11.1
	MD	152.1	23.1	0.24	1.1	2.7	1.7	1.5	0.4	0.4	1.9
F	AV	806.4	17.2	7.53	10.7	42.6	64.2	81.0	93.8	99.1	11.6
	MD	135.5	18.9	0.25	1.1	2.0	1.9	1.3	0.6	0.3	1.4
G	AV	840.6	97.8	8.58	10.1	39.9	60.3	77.2	91.6	98.4	14.7
	MD	217.0	24.5	0.23	2.1	3.1	2.9	1.8	1.3	0.8	3.1
H	AV	959.4	101.3	9.49	9.7	37.1	57.5	74.5	90.0	97.9	15.6
	MD	163.6	5.9	0.27	1.6	2.5	2.0	1.3	1.2	0.4	2.4
I	AV	1103.1	104.0	10.60	8.5	35.0	54.5	72.0	88.5	97.3	17.2
	MD	125.4	11.1	0.26	1.4	2.3	2.1	1.2	0.7	0.3	1.5
J	AV	1327.0	115.1	11.53	8.4	34.8	54.6	71.7	87.4	97.0	20.9
	MD	120.3	10.7	0.18	1.8	3.2	3.2	2.5	0.5	0.5	1.9
K	AV	1398.2	104.8	13.33	7.2	30.3	49.3	66.4	83.9	95.6	18.9
	MD	130.6	6.6	0.61	1.4	3.2	2.3	1.1	0.7	0.7	1.7

* Each set from A through K refers, respectively, to the corresponding group of stations, A through K, in table 6.

** P = Precipitation; MM = Millimeters; D = Days; T(C) = Mean Annual Temperature in Degrees Celsius
AV = Average; MD = Mean deviation

Table 9 Model of Short-Term Precipitation

Table 9a. Percent Frequencies of Hourly Precipitation per P/H*

		Millimeters per Hour					
Station Group**	P/H	≤0.51	≤2.54	≤6.35	≤12.70	≤25.40	≤50.80
A	0.86	42.0	92.2	98.5	99.6	99.9	100.0
B	1.12	38.1	88.8	97.4	99.3	99.9	100.0
C	1.31	34.9	85.2	96.3	99.1	99.8	100.0
D	1.49	32.5	82.7	94.9	98.2	99.5	99.9
E	1.68	29.6	79.6	93.8	98.1	99.5	100.0
F	1.91	27.5	76.2	92.0	97.1	99.3	99.9
G	2.23	27.5	73.5	89.7	95.8	98.8	99.8
H	2.70	24.9	70.5	88.2	95.3	98.7	99.9
I	3.36	21.0	66.0	84.7	93.2	97.9	99.6

Table 9b. Percent Frequencies of Daily Precipitation per P/D*

		Millimeters per Day					
Station Group	P/D	≤0.51	≤2.54	≤6.35	≤12.70	≤25.40	≤50.80
A	3.68	14.2	57.7	80.9	93.0	98.2	99.5
B	4.51	14.0	56.0	78.5	90.9	98.6	99.8
C	5.35	14.7	50.9	73.7	87.5	96.0	99.4
D	5.82	12.7	48.8	71.5	86.3	96.0	99.3
E	6.50	11.1	43.3	66.9	84.2	96.0	99.3
F	7.53	10.7	42.6	64.2	81.0	93.8	99.1
G	8.58	10.1	39.9	60.3	77.2	91.6	98.4
H	9.49	9.7	37.1	57.5	74.5	90.0	97.9
I	10.60	8.5	35.0	54.5	72.0	88.5	97.3
J	11.53	8.4	34.8	54.6	71.7	87.4	97.0
K	13.33	7.2	30.3	49.3	66.4	83.9	95.6

* P = Precipitation
H = Hour
D = Day

** Each set from A through K refers, respectively, to the corresponding group of stations, A through K, in tables 5 and 6.

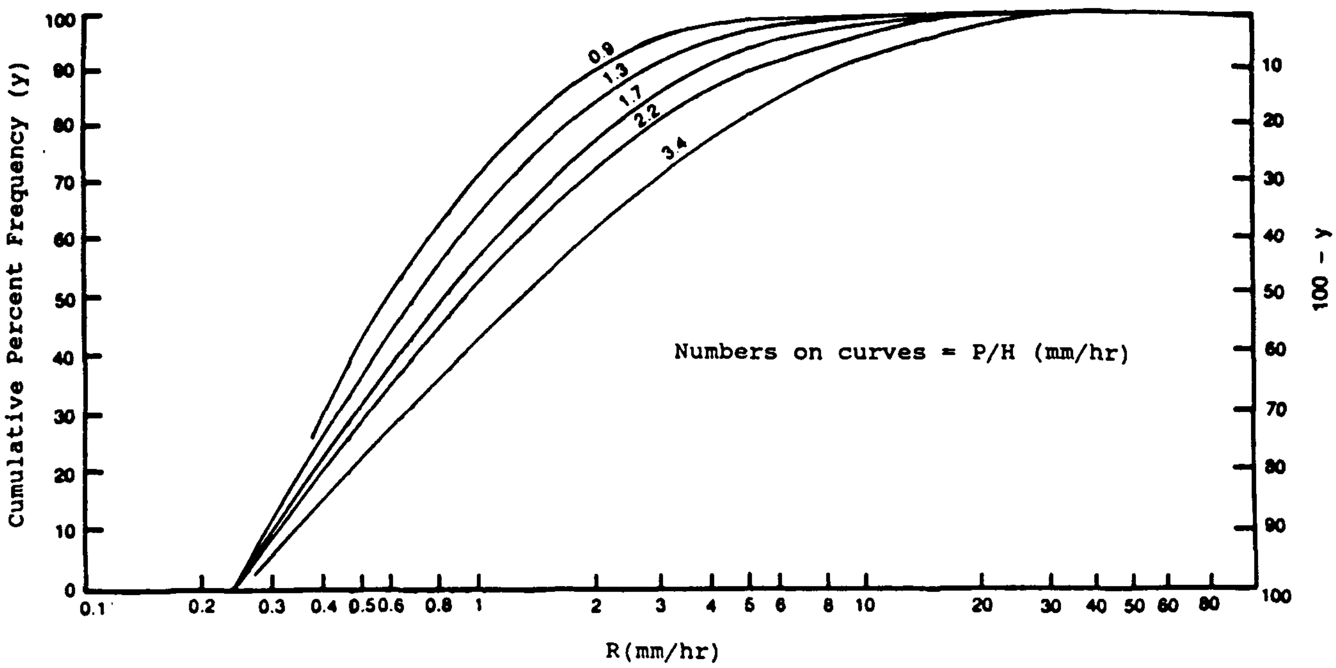

Figure 1. Hourly Precipitation Distributions per P/H

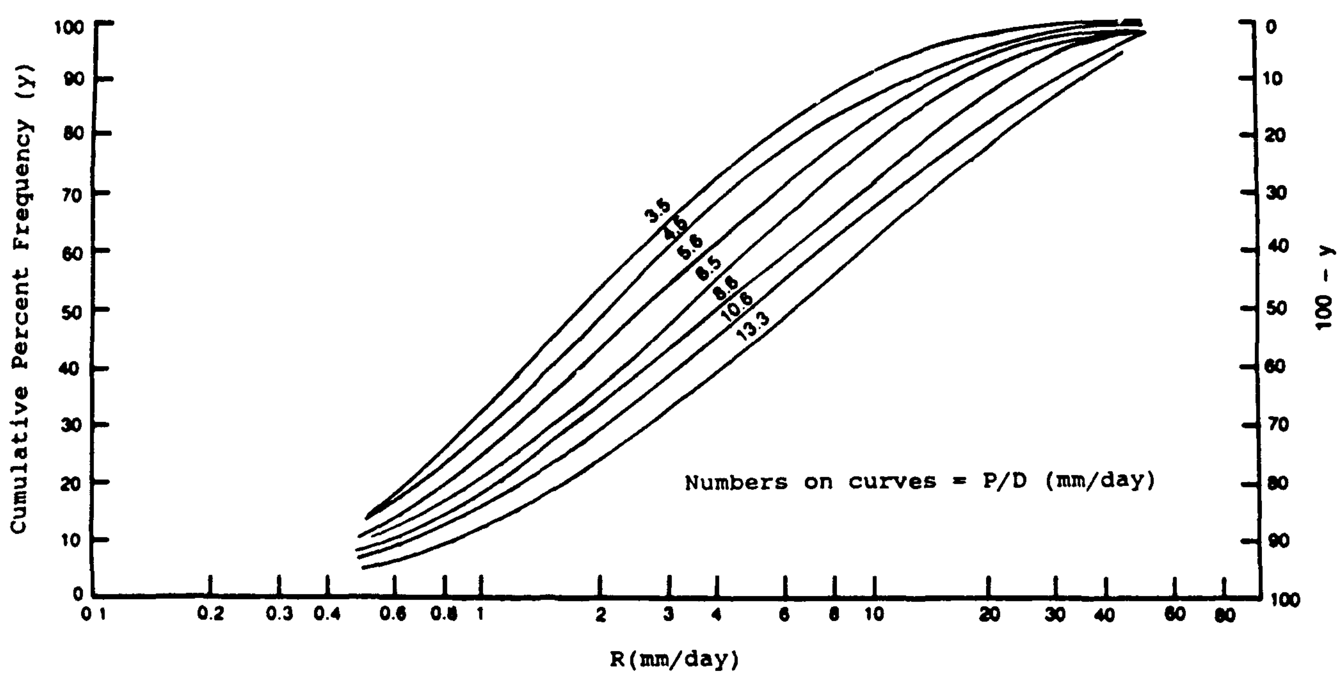

Figure 2. Daily Precipitation Distributions per P/D

Figure 3. Maps of Mean Annual Precipitation (1951-1960)

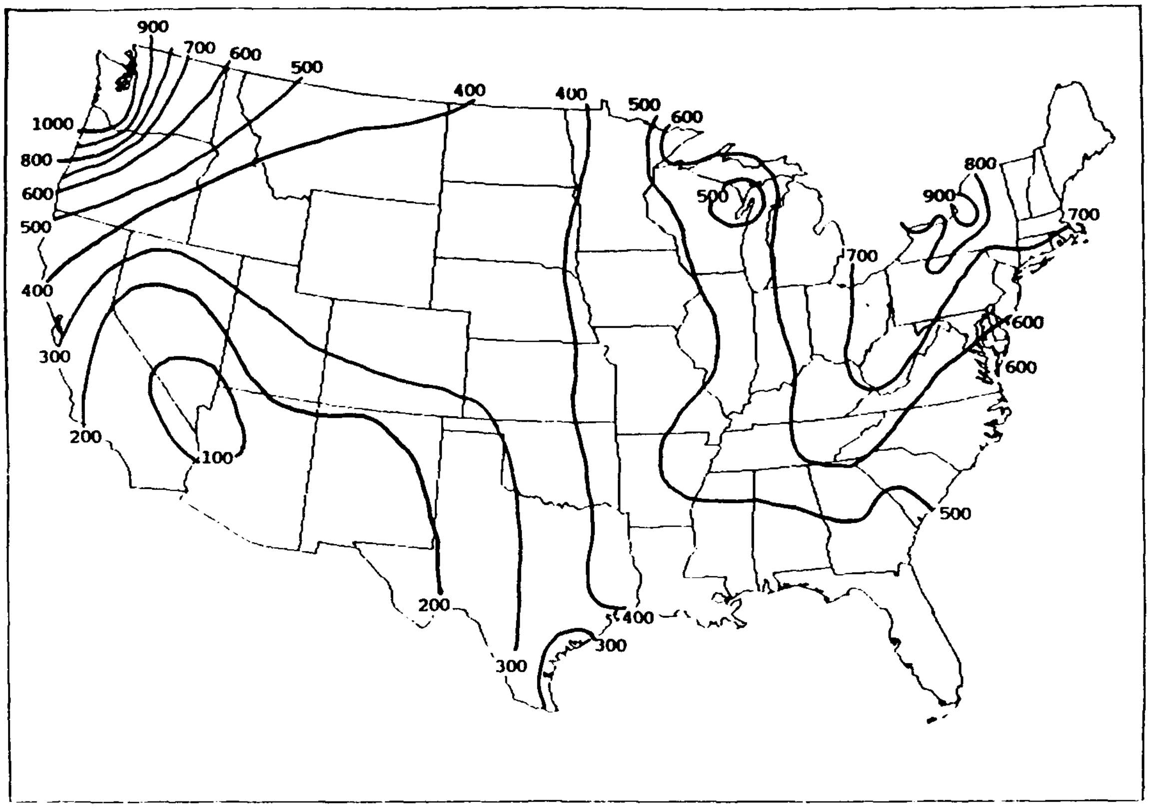

Figure 3a. Number of Hours (H) with Precipitation > .25 mm

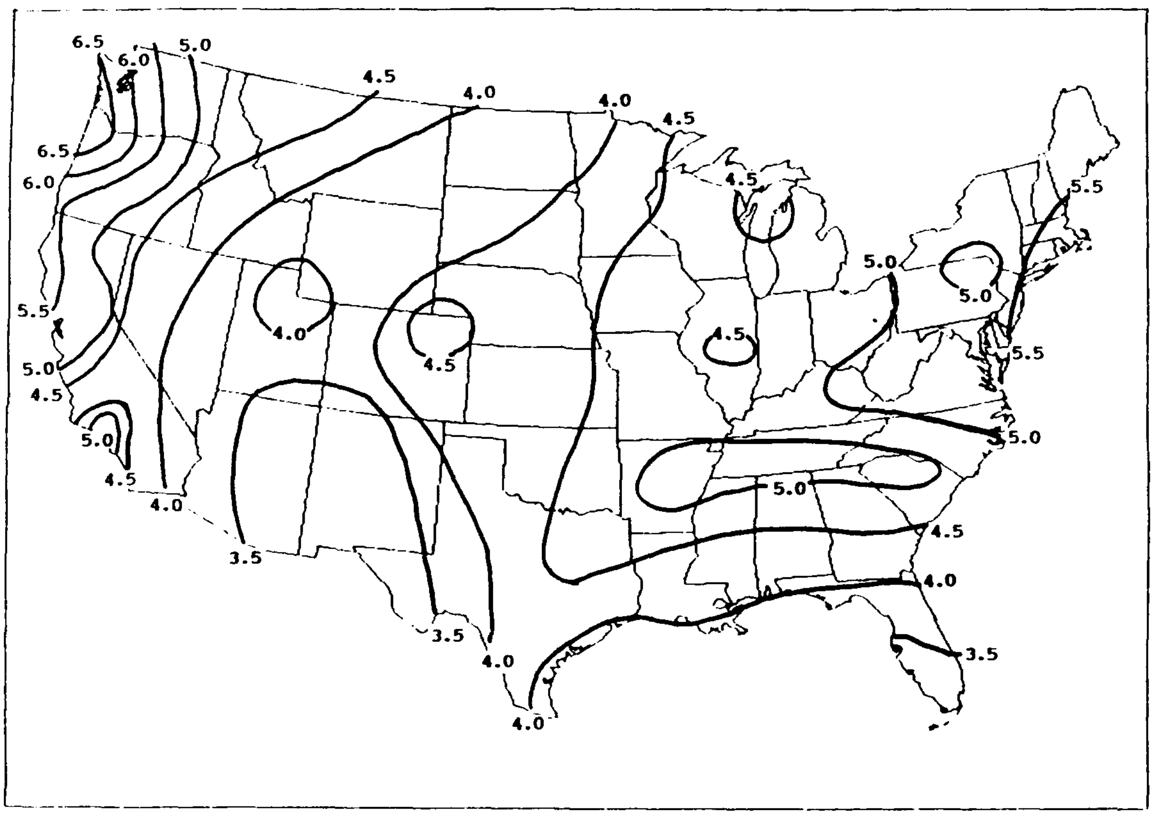

Figure 3b. Hours of Precipitation per Days of Precipitation (H/D)

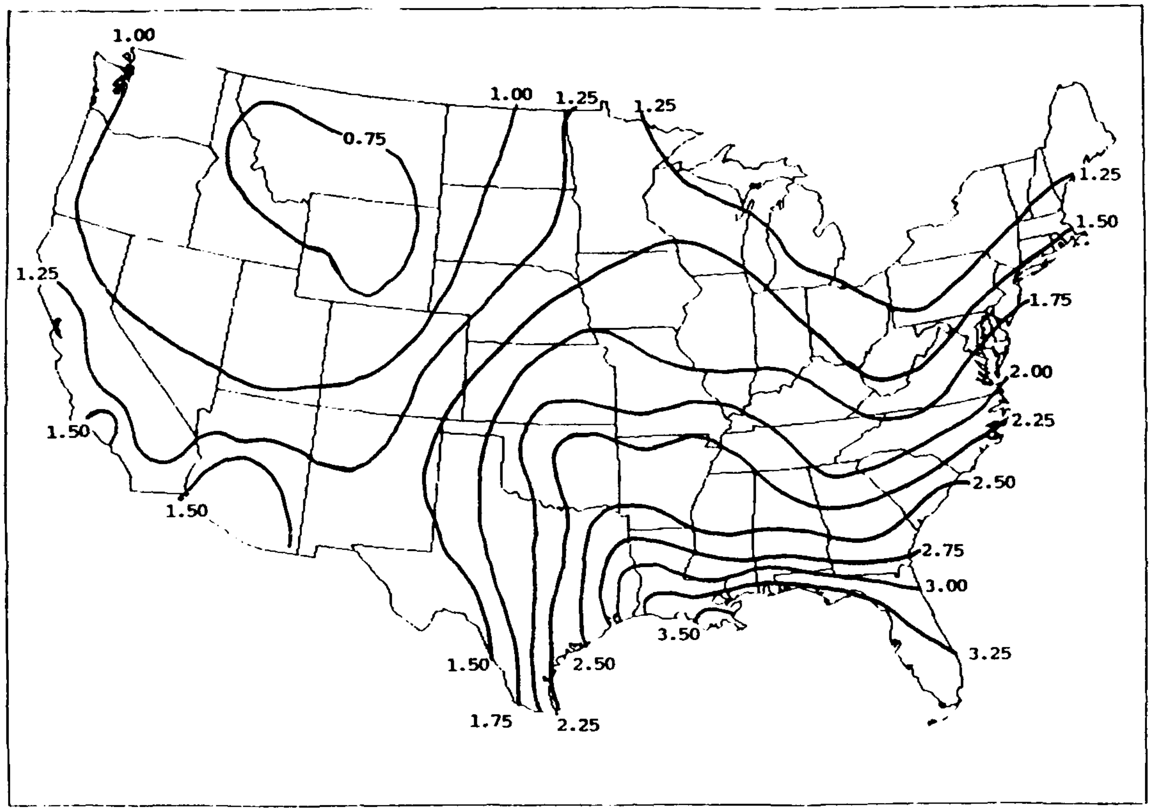

Figure 3c. Total Precipitation per Number of Hours: P/H (mm/hr)

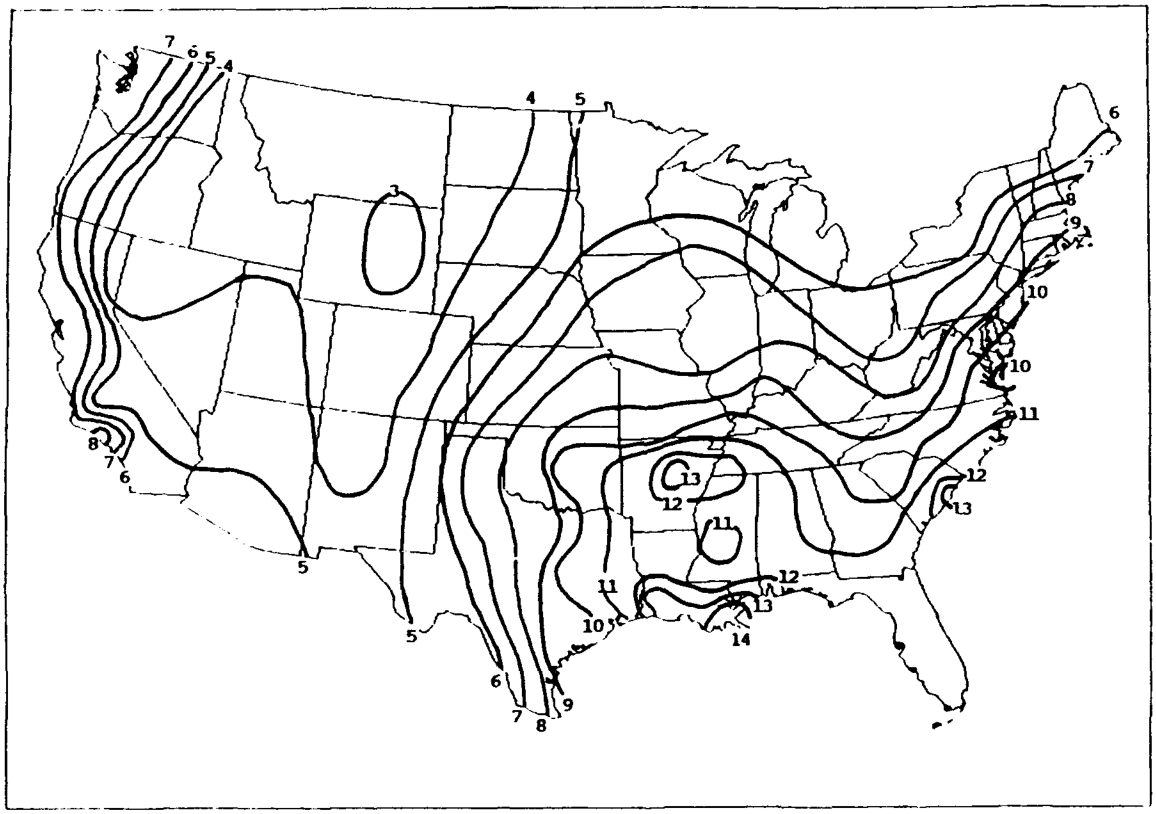

Figure 3d. Total Precipitation per Number of Days: P/D (mm/day)

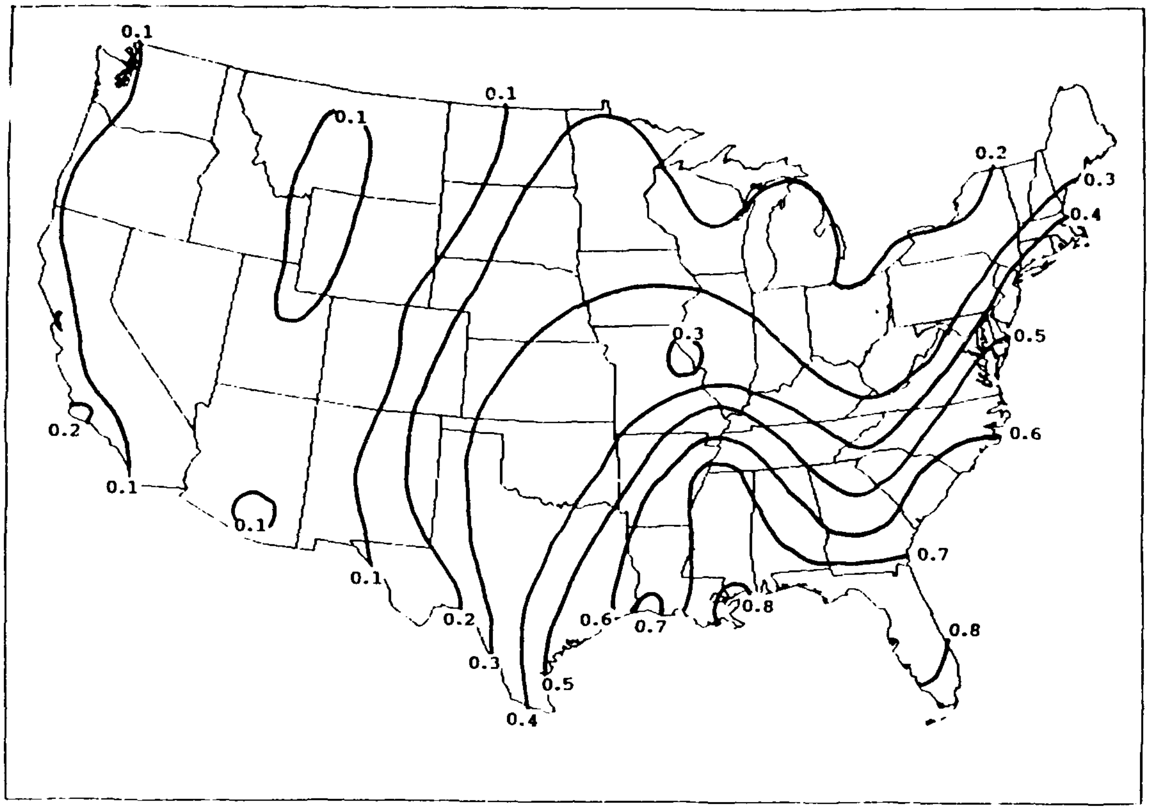

Figure 3e. Percent Hours per Year with Precipitation > 6.35 mm

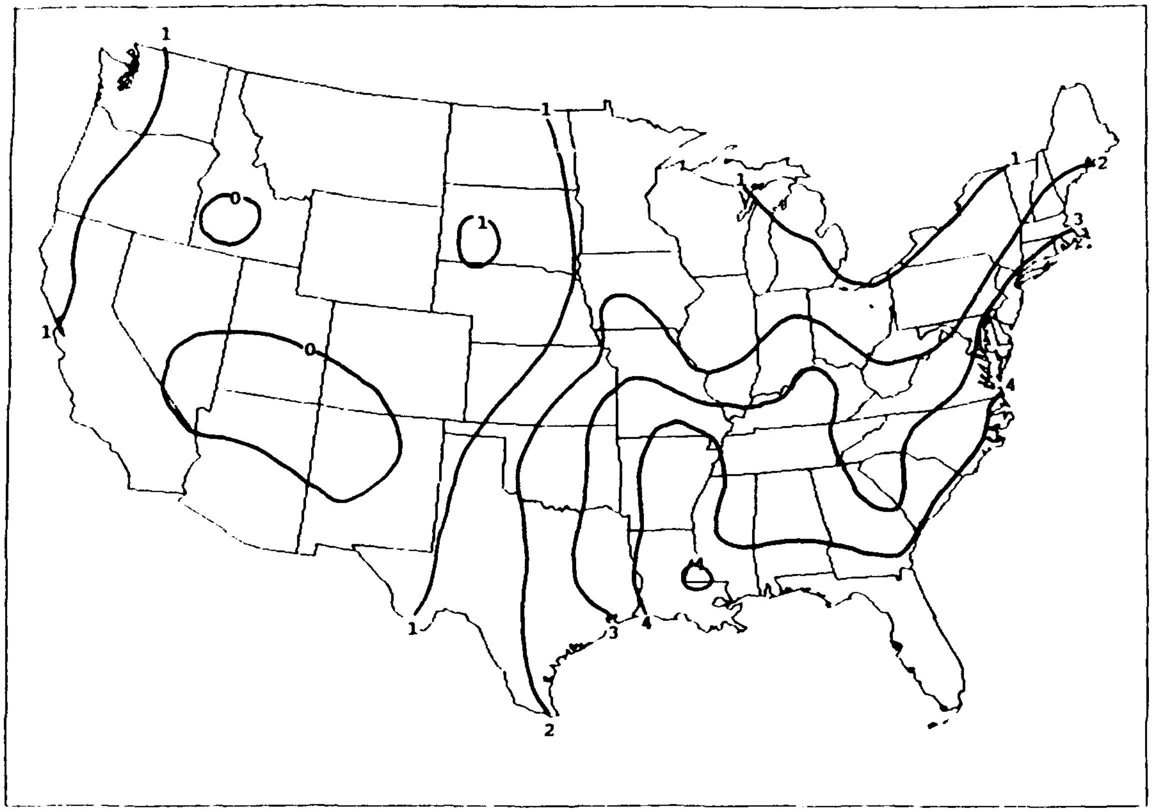

Figure 3f. Percent Days per Year with Precipitation > 25.4 mm

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APPENDIX A: EQUATIONS

Two equations that yield reasonable estimates of short-term precipitation, given the required climatological information, are as follows

$$y = 3.6 + 21.0(\ln x) \tag{A1}$$

and

$$y = A + B(\ln R) \tag{A2}$$

where Y = cumulative percent frequency

and x = cumulative percent amount

R = precipitation rate (mm/day or mm/hr)

A, B = constants

Both equations have been discussed in detail and utilized previously (Wexler 1986). Although the general (or default) equation (A1) recovers both hourly and daily precipitation frequencies, it is not necessarily dependable for extreme precipitation, which may be >6.35 mm for some of the hourly distribution or >25.4 mm for some of the daily distributions. For the first program (Appendix B), only equation (A2) is used for determining hourly rates. However, both equations are employed for daily precipitation.

For each average P/H (table 8), therefore, from 0.86 to 3.4 mm/hr, a series of constants are obtained for selected precipitation class intervals, as from 0.51 to 2.54 mm/hr, or from 2.54 to 6.35 mm/hr, and so on. The final constants, A and B, for equation (A2), then each become function of P/H.

Similarly, for each average P/D (table 8), from 3.7 to 13.3 mm/day, constants for equation (A2) are obtained for the class interval 25.4 to 50.8 mm/day. Each of the final constants A and B for equation (A2) for this class become a function of P/D. Note that equation (A2) is limited to >25.4 mm for P/D<15 mm/day. Equation (A1) is relied upon for all other situations (for hourly as well as daily frequencies).

All equations were obtained by least squares, with coefficients of determination equal to or greater than 0.90. Tables A1 and A2 demonstrate the efficiency of such equations for recovering hourly or daily precipitation rates, respectively. Table A1 includes a comparison of the estimated and observed cumulative percent frequencies (y) on which the various equations were based. To obtain h, the number of hours, or d, the number of days with precipitation equal to or greater than any selected rate,

$$h = (100-y)*H/100 \tag{A3}$$

$$d = (100-y)*D/100 \tag{A4}$$

Equations (A3) and (A4) may be utilized with the appropriate P/H or P/D in figures 1 or 2 or tables 5 to 8 for immediate estimates of short-term precipitation.

TABLE A1. TEST OF EQUATIONS FOR HOURLY DISTRIBUTIONS

					HOURLY PPT FREQUENCIES R(MM)				
STATION	**P(MM)**	**H**	**P/H**		**≤0.51**	**≤2.54**	**≤6.35**	**≤12.70**	**≤25.40**
GREAT FALLS	389.0	456.0	0.85						
CUM%FREQ				EST	42.6	92.6	99.2	99.9	100.0
				OBS	44.5	92.3	98.7	99.8	100.0
HOURS>R				EST	266.5	33.9	3.7	0.6	0.1
				OBS	253.1	35.1	6.0	1.0	0.0
SYRACUSE	966.0	923.0	1.05						
CUM%FREQ				EST	38.9	89.5	97.9	99.4	99.9
				OBS	40.7	89.7	97.4	99.2	99.9
HOURS>R				EST	564.3	96.5	19.2	5.6	1.3
				OBS	547.0	95.1	24.0	7.0	1.0
ALBUQUERQUE	185.0	154.0	1.20						
CUM%FREQ				EST	36.7	87.1	96.9	99.0	99.8
				OBS	33.1	85.7	96.8	99.4	100.0
HOURS>R				EST	97.5	19.8	4.8	1.5	0.4
				OBS	103.0	22.0	5.0	1.0	0.0

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TABLE A1. TEST OF EQUATIONS FOR HOURLY DISTRIBUTIONS--Continued

					HOURLY PPT FREQUENCIES				
					R(MM)				
STATION	**P(MM)**	**H**	**P/H**		**≤0.51**	**≤2.54**	**≤6.35**	**≤12.70**	**≤25.40**
ALBANY	981.0	703.0	1.40						
CUM%FREQ				EST	34.0	84.1	95.6	98.5	99.6
				OBS	30.4	85.9	96.7	99.0	99.9
HOURS>R				EST	463.9	111.8	30.8	10.3	2.6
				OBS	489.0	99.1	23.0	7.0	1.0
CHICAGO	858.0	565.0	1.52						
CUM%FREQ				EST	32.3	82.2	94.8	98.2	99.5
				OBS	35.2	83.2	94.7	98.2	99.3
HOURS>R				EST	382.6	100.8	29.3	10.0	2.6
				OBS	366.1	94.9	30.0	10.0	4.0
BURBANK	351.0	198.0	1.77						
CUM%FREQ				EST	28.8	78.2	93.1	97.6	99.4
				OBS	27.3	73.7	91.4	98.5	100.0
HOURS>R				EST	141.1	43.2	13.6	4.7	1.2
				OBS	144.0	52.0	17.0	3.0	0.0

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TABLE A1. TEST OF EQUATIONS FOR HOURLY DISTRIBUTIONS--Continued

					HOURLY PPT FREQUENCIES R(MM)				
STATION	**P(MM)**	**H**	**P/H**		**≤ 0.51**	**≤ 2.54**	**≤ 6.35**	**≤ 12.70**	**≤ 25.40**
ATLANTA	1126.0	523.0	2.15						
CUM%FREQ				EST	27.8	74.1	90.5	96.4	98.9
				OBS	25.0	72.8	91.2	96.4	98.9
HOURS>R				EST	377.8	135.3	49.7	18.9	5.7
				OBS	392.3	142.3	46.0	19.0	6.0
LITTLE ROCK	1272.0	504.0	2.52						
COM%FREQ				EST	25.7	71.6	88.8	95.4	98.6
				OBS	26.4	71.2	90.3	96.6	99.8
HOURS>R				EST	374.5	143.0	56.7	23.2	7.1
				OBS	370.9	145.2	49.0	17.0	1.0
GALVESTON	867.0	338.0	2.57						
CUM%FREQ				EST	25.5	71.4	88.6	95.3	98.6
				OBS	26.9	71.6	88.5	95.9	99.1
HOURS>R				EST	251.9	96.8	38.7	15.9	4.9
				OBS	247.0	96.0	39.0	14.0	3.0

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TABLE A1. TEST OF EQUATIONS FOR HOURLY DISTRIBUTIONS--Continued

					HOURLY PPT FREQUENCIES R(MM)				
STATION	**P(MM)**	**H**	**P/H**		**≤ 0.51**	**≤ 2.54**	**≤ 6.35**	**≤ 12.70**	**≤ 25.40**
NEW ORLEANS	1587.0	459.0	3.46						
CUM%FREQ				EST	20.5	65.3	84.4	92.9	97.8
				OBS	22.9	67.3	85.2	93.5	98.0
HOURS>R				EST	364.8	159.1	71.7	32.6	10.0
				OBS	353.9	150.1	68.0	30.0	9.0

TABLE A2. TEST OF EQUATIONS FOR DAILY DISTRIBUTIONS

STATION	P	D	P/D		NO. DAYS WITH PPT>R, R(MM) ≤ 2.54	≤ 6.35	≤ 12.70	≤ 25.40	≤ 50.80
ALBUQUERQUE	185.0	52.0	3.56	EST	20.6	10.6	3.0	0.3	0.0
				OBS	21.0	9.0	3.0	0.0	0.0
DENVER	311.0	83.0	3.75	EST	33.7	17.8	5.7	0.7	0.0
				OBS	36.0	18.0	7.0	2.0	0.0
GREAT FALLS	389.0	100.0	3.89	EST	41.4	22.2	7.6	1.1	0.0
				OBS	43.0	18.0	7.0	1.0	0.0
SALT LAKE CTY	353.0	87.0	4.06	EST	36.8	20.1	7.4	1.1	0.0
				OBS	38.0	20.0	7.0	1.0	0.0
LAS VEGAS	102.0	22.0	4.64	EST	9.9	5.7	2.5	0.5	0.0
				OBS	10.0	4.0	2.0	0.0	0.0
DULUTH	740.0	133.0	5.56	EST	65.1	39.5	20.1	4.9	0.8
				OBS	63.0	32.0	17.0	5.0	1.0
SYRACUSE	966.0	170.0	5.68	EST	83.9	51.2	26.5	6.6	1.1
				OBS	90.0	48.0	20.0	5.0	1.0
DETROIT	794.0	137.0	5.80	EST	68.2	41.8	21.9	5.5	1.0
				OBS	70.0	39.0	19.0	5.0	1.0
LAREDO	420.0	72.0	5.83	EST	35.9	22.1	11.6	3.0	0.5
				OBS	31.0	17.0	12.0	6.0	1.0

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TABLE A2. TEST OF EQUATIONS FOR DAILY DISTRIBUTIONS--Continued

					NO. DAYS WITH PPT>R				
					R(MM)				
STATION	**P**	**D**	**P/D**		**≤ 2.54**	**≤ 6.35**	**≤ 12.70**	**≤ 25.40**	**≤ 50.80**
DAYTON	893.0	131.0	6.82	EST	69.7	44.5	25.4	7.4	1.5
				OBS	75.0	44.0	22.0	6.0	1.0
CHARLESTON	1060.0	152.0	6.97	EST	81.6	52.3	30.2	8.9	1.9
				OBS	88.0	54.0	28.0	7.0	1.0
HARRISBURG	923.0	124.0	7.44	EST	68.3	44.4	26.3	8.2	1.8
				OBS	73.0	47.0	23.0	7.0	1.0
AMARILLO	488.0	66.0	7.39	EST	36.2	23.5	13.9	4.3	0.9
				OBS	35.0	20.0	11.0	4.0	1.0
DES MOINES	773.0	104.0	7.43	EST	57.2	37.2	22.1	6.9	1.5
				OBS	56.0	36.0	18.0	6.0	1.0
INDIANAPOLIS	994.0	125.0	7.95	EST	70.5	46.5	28.3	9.3	2.1
				OBS	77.0	47.0	25.0	8.0	1.0
FORT WORTH	709.0	83.0	8.54	EST	48.1	32.1	20.0	6.9	1.6
				OBS	50.0	34.0	19.0	8.0	2.0
KNOXVILLE	1128.0	126.0	8.95	EST	74.2	50.0	31.7	11.3	2.6
				OBS	82.0	56.0	32.0	10.0	1.0
BURBANK	351.0	37.0	9.49	EST	22.3	15.1	9.7	3.6	0.9
				OBS	21.0	15.0	9.0	4.0	1.0

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TABLE A2. TEST OF EQUATIONS FOR DAILY DISTRIBUTIONS--Continued

STATION	P	D	P/D		NO. DAYS WITH PPT>R, R(MM) ≤ 2.54	≤ 6.35	≤ 12.70	≤ 25.40	≤ 50.80
NORFOLK	1162.0	118.0	9.85	EST	71.9	49.2	32.0	12.3	2.9
				OBS	74.0	51.0	31.0	14.0	3.0
WACO	827.0	78.0	10.60	EST	48.7	33.7	22.4	9.0	2.2
				OBS	47.0	33.0	20.0	9.0	2.0
MONTGOMERY	1183.0	108.0	10.95	EST	68.2	47.4	31.7	13.1	3.2
				OBS	70.0	48.0	31.0	14.0	3.0
W.PALM BEACH	1534.0	136.0	11.28	EST	86.7	60.6	40.8	17.2	4.2
				OBS	88.0	60.0	34.0	16.0	4.0
HOUSTON	1133.0	98.0	11.56	EST	63.0	44.1	29.9	12.8	3.2
				OBS	59.0	40.0	25.0	12.0	4.0
LITTLE ROCK	1272.0	98.0	12.98	EST	65.4	46.5	32.3	15.0	3.8
				OBS	66.0	48.0	33.0	16.0	4.0
CHARLESTON	1536.0	115.0	13.36	EST	77.4	55.3	38.6	18.3	4.6
				OBS	88.0	63.0	39.0	18.0	6.0

APPENDIX B: COMPUTER PROGRAMS

This section contains the following programs, namely

1. HRS:EST. Estimates the number of hours with precipitation equal to or greater than each of the rates indicated.

2. EST-DAYS. Estimates the number of days with precipitation equal to or greater than each of the rates indicated.

3. DAYRATE. Estimates the number of days with precipitation equal to or greater than a selected rate for a specified interval of time.

Although the program output in any of the above instances would ordinarily be limited to estimates only, observations are added in the examples given in order to demonstrate the utility or limits of the respective program. In as much as the equations were determined originally on the basis of annual data only for stations in the United States (table A1 and A2), the above programs are applied to other areas or intervals of time, as indicated.

Program #1: Stations in Southeast Asia.

Program #2: Monthly precipitation for stations for which only annual short-term precipitation was originally available.

Program #3: A variety of situations.

In all the above cases, the estimates appear to give reasonable results. For any given area, however, appropriate equations should be tailored specifically for the precipitation regime at hand.

TABLE B1. PROGRAM #1. HRS:EST

```
2 REM "HRS:EST"
3 REM INTERACTIVE HOURLY FREQ
4 OPTION BASE 1
5 DATA 0.51,2.54, 6.35,12.7,25.4
6 DIM R(6),Y(6),F(6)
8 FOR N = 1 TO 5
9 READ R(N)
10 NEXT N
11 LPRINT " ",,,,"NO. HOURS WITH PPT >R"
12 LPRINT
13 LPRINT" ",,,,"        R(MM/HR)"
14 LPRINT
16 LPRINT"STATION"," P(MM)  ";"   H    ";"  P/H   ";
17 LPRINT"        ";
18 LPRINT USING "###.##  ";R(1),R(2),R(3),R(4),R(5)
19 LPRINT
20 PRINT"ENTER STATION"
22 INPUT S$
24 PRINT"ENTER PRECIPITATION (MM)"
26 INPUT P
28 PRINT"ENTER NUMBER HOURS OF PRECIPITATION"
30 INPUT H
32 I = P/H
40 IF (I<2) GOTO 60
42 GOSUB 300
44 GOSUB 80
60 GOSUB 200
80 GOSUB 100
82 PRINT "ANOTHER CASE? Y?N?"
84 INPUT U$
86 IF (U$="Y") GOTO 20
90 END
100 REM " LPRINT"
102 COMMON S$, P, H, I, R(6),Y(6), F(6)
103 COMMON A(5),B(5)
104 FOR N = 1 TO 5
106 Z = LOG(R(N))
110 Y(N) = A(N) + B(N) * Z
120 IF (Y(N) <0) THEN Y(N) =0 : GOTO 140
130 IF (Y(N) >100) THEN Y(N) =100
140 F(N) =(100 - Y(N)) * H/100
142 NEXT N
144 LPRINT S$,
146 LPRINT USING"####.#  ";P,H,
148 LPRINT USING"###.##  ";I,
159 LPRINT"        ";
```

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TABLE B1. PROGRAM #1. HRS:EST--Continued

```
160 LPRINT USING"####.#  ";F(1),F(2),F(3),F(4),F(5)
170 LPRINT
180 RETURN
200 REM "I<2.0"
204 COMMON I, A(5),B(5)
205 A(1) =75.83-14.88*I
206 A(2) =107.43 -25.02*I
208 A(3) =110.59 -16.75*I
210 A(4) = 107.21 - 9.099999 * I
211 A(5) = A(4)
212 B(1) =33.26 -1.42*I
214 B(2) =-1.65 +10.08*I
216 B(3) =-3.14 +5.51*I
217 B(4) =-2.06 + 2.61 * I
218 B(5) = B(4)
220 RETURN
300 REM "I>2.0"
304 COMMON I, A(5),B(5)
306 A(1) = 60.27 - 6.06 * I
308 A(2) = 76.56 - 8.83 * I
310 A(3)= 96.79999 - 10.31* I
312 A(4) = 107.41 - 9.41 * I
314 A(5) = A(4)
316 B(1) = 30.52 - .75 * I
318 B(2) = 12.97 + 2.24 * I
320 B(3) = 2.05 + 3.04 * I
322 B(4) = - 2.07 + 2.65 * I
324 B(5) = B(4)
330 RETURN
```

TABLE B2. SAMPLE OUTPUT FOR PROGRAM #1

				NO. HOURS WITH PPT >R R(MM/HR)				
STATION	P(MM)	H	P/H	0.51	2.54	6.35	12.70	25.40
LOEI	1026.2	367.0	2.80	278.2	110.8	46.0	19.6	6.0
KRAKOR	1292.9	388.0	3.33	305.7	131.2	58.4	26.2	8.1

TABLE B3. ESTIMATES VS. OBSERVATIONS FOR PROGRAM #1

STATION	P(MM)	H	P/H		NO. HOURS WITH PPT >R R(MM/HR) 0.51	2.54	6.35	12.70	25.40
LOEI	1026.2	367.0	2.80	EST	278.2	110.8	46.0	19.6	6.0
				OBS	289.0	97.0	40.0	14.0	3.0
KRAKOR	1292.9	388.0	3.33	EST	305.7	131.2	58.4	26.2	8.1
				OBS	318.0	123.0	57.0	25.0	7.0
STUNG TRENG	1564.6	427.0	3.66	EST	344.3	153.9	70.9	32.7	10.1
				OBS	366.0	145.0	60.0	30.0	11.0
KRATIE	1145.5	288.0	3.98	EST	237.2	109.9	52.0	24.5	7.5
				OBS	253.0	110.0	47.0	24.0	5.5
O RAING	2415.5	568.0	4.25	EST	476.6	227.3	110.0	52.4	16.2
				OBS	555.0	252.0	109.0	44.0	9.5
ROI	1176.0	240.0	4.90	EST	210.0	106.5	53.7	26.3	8.1
				OBS	233.0	118.0	52.0	23.0	7.5
VEUNESAI	2100.6	414.0	5.07	EST	366.2	188.6	96.1	47.3	14.6
				OBS	405.0	222.0	100.0	39.0	11.0

TABLE B4. PROGRAM #2. EST-DAYS

```
2 REM "EST-DAYS"
3 LPRINT " ",,," NO. DAYS WITH PPT > R(MM)"
4 OPTION BASE 1
5 LPRINT
6 DATA 2.54,6.35,12.70,25.4,50.8
8 DIM R(6),Y(6),F(6)
9 LPRINT
10 LPRINT" ",,,"             R(MM)"
11 LPRINT
12 FOR L = 1 TO 5
14 READ R(L)
16 NEXT L
18 LPRINT"STATION","    P       D       P/D    ";
20 LPRINT USING"###.##    ";R(1),R(2),R(3),R(4),R(5)
21 LPRINT
22 A=3.6
24 B=21!
30 PRINT "ENTER STATION"
32 INPUT S$
34 PRINT "ENTER TOTAL PRECIPITATION IN MILLIMETERS"
36 INPUT P
38 PRINT " ENTER NUMBER OF DAYS OF PRECIPITATION"
40 INPUT D
41 I = P/D
42 A1 = 120.02 - 6.84 * I
44 B1 = - 4.63 + 1.63 * I
46 FOR L = 1 TO 3
48 S = R(L)/I
50 X = S * B
52 Y(L) = A + B * (LOG(X))
54 IF (Y(L)<0) THEN Y(L) =0
56 IF (Y(L)>100) THEN Y(L) = 100
58 F(L) = (100-Y(L))*D/100
60 NEXT L
62 FOR L = 4 TO 5
64 Y(L) = A1 + B1 * (LOG(R(L)))
66 IF (Y(L)>100) THEN Y(L) = 100
67 F(L) = (100-Y(L))*D/100
68 NEXT L
70 LPRINT S$,
72 LPRINT USING"####.#   ";P,D,
73 LPRINT USING "###.##   ";I,
80 LPRINT USING "####.#   ";F(1),F(2),F(3),F(4),F(5)
90 PRINT "ANOTHER CASE? Y? N?"
92 INPUT A$
94 IF A$ ="Y" THEN GOTO 30
96 END
```

TABLE B5. SAMPLE OUTPUT FOR PROGRAM #2

				NO. DAYS WITH PPT > R(MM)				
				R(MM)				
STATION	P	D	P/D	2.54	6.35	12.70	25.40	50.80
EL PASO	197.4	47.0	4.20	20.2	11.2	4.3	0.7	0.0
HOUSTON	1224.0	104.0	11.77	67.3	47.2	32.1	13.9	3.4

TABLE B6. ESTIMATES VS. OBSERVATIONS FOR PROGRAM #2

					NO. DAYS WITH PPT > R			
					R(MM)			
STATION	P	D	P/D		6.35	12.70	25.40	50.80
EL PASO	197.4	47.0	4.20	EST	11.2	4.3	0.7	0.0
				OBS	10.1	3.8	1.0	0.1
JAN	9.9	4.0	2.48	EST	0.5	0.0	0.0	0.0
				OBS	0.4	0.1	0.0	0.0
FEB	10.7	3.0	3.57	EST	0.6	0.2	0.0	0.0
				OBS	0.7	0.2	0.0	0.0
MAR	9.9	2.0	4.95	EST	0.5	0.3	0.1	0.0
				OBS	0.7	0.2	0.0	0.0
APR	6.1	2.0	3.05	EST	0.3	0.1	0.0	0.0
				OBS	0.4	0.2	0.0	0.0
MAY	8.1	2.0	4.05	EST	0.5	0.2	0.0	0.0
				OBS	0.4	0.1	0.1	0.0
JUN	15.2	3.0	5.07	EST	0.8	0.4	0.1	0.0
				OBS	0.7	0.4	0.1	0.0
JUL	38.9	8.0	4.86	EST	2.1	1.0	0.2	0.0
				OBS	2.8	0.9	0.3	0.0
AUG	28.4	7.0	4.06	EST	1.6	0.6	0.1	0.0
				OBS	1.5	0.6	0.3	0.1
SEP	29.5	5.0	5.90	EST	1.5	0.8	0.2	0.0
				OBS	0.8	0.6	0.2	0.0
OCT	19.8	4.0	4.95	EST	1.1	0.5	0.1	0.0
				OBS	1.2	0.4	0.1	0.0
NOV	8.1	3.0	2.70	EST	0.4	0.0	0.0	0.0
				OBS	0.1	0.0	0.0	0.0
DEC	12.7	4.0	3.18	EST	0.7	0.1	0.0	0.0
				OBS	0.4	0.1	0.0	0.0

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TABLE B6. ESTIMATES VS. OBSERVATIONS FOR PROGRAM #2--Continued

STATION	P	D	P/D		NO. DAYS WITH PPT > R, R(MM) 6.35	12.70	25.40	50.80
HOUSTON	1224.0	104.0	11.77	EST	47.2	32.1	13.9	3.4
				OBS	40.5	25.6	12.4	4.3
JAN	90.7	11.0	8.25	EST	4.2	2.6	0.9	0.2
				OBS	2.7	1.6	0.8	0.1
FEB	89.9	7.0	12.84	EST	3.3	2.3	1.1	0.3
				OBS	3.5	2.3	0.9	0.3
MAR	68.1	10.0	6.81	EST	3.4	1.9	0.6	0.1
				OBS	2.3	1.1	0.3	0.2
APR	89.9	7.0	12.84	EST	3.3	2.3	1.1	0.3
				OBS	3.8	2.1	1.3	0.6
MAY	129.5	8.0	16.19	EST	4.2	3.0	1.6	0.4
				OBS	3.3	2.0	0.9	0.3
JUN	114.8	7.0	16.40	EST	3.7	2.6	1.4	0.4
				OBS	2.9	2.0	1.2	0.6
JUL	104.6	10.0	10.46	EST	4.3	2.8	1.1	0.3
				OBS	3.8	2.7	1.6	0.6
AUG	110.5	11.0	10.05	EST	4.6	3.0	1.2	0.3
				OBS	4.3	2.6	1.0	0.1
SEP	118.1	10.0	11.81	EST	4.5	3.1	1.3	0.3
				OBS	3.3	2.0	1.1	0.5
OCT	102.9	7.0	14.70	EST	3.5	2.5	1.3	0.3
				OBS	3.0	2.0	1.3	0.7
NOV	102.4	8.0	12.80	EST	3.8	2.6	1.2	0.3
				OBS	3.4	2.3	1.3	0.3
DEC	102.6	8.0	12.83	EST	3.8	2.6	1.2	0.3
				OBS	4.2	2.5	0.7	0.1

TABLE B7. PROGRAM #3. DAYRATE

```
1 REM "DAYRATE" JUL 87 RLW
2 OPTION BASE 1
3 PRINT" PROGRAM TO ESTIMATE PRECIPITATION FREQUENCIES"
8 LPRINT"STATION","PERIOD"," P(MM)   ";"    D    ";"   P/D    ";"R(MM/DAY)";
10 LPRINT" DAYS>R";"  OBS"
12 LPRINT
14 PRINT"ENTER STATION"
16 INPUT S$
20 PRINT"PERIOD: YEAR? MONTH? WHICH?  SEASON? WHICH?"
22 INPUT A$
24 PRINT"ENTER TOTAL PRECIPITATION IN MILLIMETERS"
26 INPUT P
28 PRINT" ENTER NUMBER OF DAYS WITH PRECIPITATION"
30 INPUT D
32 A = 3.6
34 B = 21!
36 I = P/D
38 PRINT"ENTER PRECIPITATION RATE,R(MM/DAY)"
40 INPUT R
42 S = R/I
44 IF (R<25.4) GOTO 60
46 IF (I>15) GOTO 60
48 A1 = 120.02 - 6.84 * I
50 B1 = -4.63 + 1.63 * I
52 Y = A1 + B1 * (LOG(R))
54 GOTO 64
60 X = S * B
62 Y = A + (B*LOG(X))
64 IF (Y<0) THEN Y = 0: GOTO
66 IF (Y>100) THEN Y = 100
70 F = (100-Y)*D/100
80 LPRINT S$,
82 LPRINT A$,
84 LPRINT USING "####.#  ";P,D,I,R,F
90 PRINT"ANOTHER CASE? Y? N?"
92 INPUT C$
94 IF C$ = "Y" THEN GOTO 14
96 END
```

TABLE B8. SAMPLE OUTPUT FOR PROGRAM #3

STATION	PERIOD	P(MM)	D	P/D	R(MM/DAY)	DAYS>R
KHLONG KLAI	YEAR	4922.0	192.0	25.6	35.0	49.8

TABLE B9. ESTIMATES VS. OBSERVATIONS FOR PROGRAM #3

STATION	PERIOD	P(MM)	D	P/D	R(MM/DAY)	DAYS>R	OBS
KHLONG KLAI	YEAR	4922.0	192.0	25.6	35.0	49.8	45.0
RAMONG	YEAR	4347.0	207.0	21.0	10.0	99.5	105.0
CHANTHABURI	YEAR	3305.0	171.0	19.3	35.0	34.2	29.0
BROCKEN	JUL	160.0	20.0	8.0	10.0	5.6	5.0
BROCKEN	MAY	99.1	17.0	5.8	10.0	3.6	3.0
WASH.D.C.	SUMMER	316.7	29.2	10.8	6.4	12.8	12.8
WASH.D.C.	AUTUMN	202.2	24.0	8.4	12.7	5.7	5.0
TUCSON	SUMMER	142.7	25.8	5.5	6.4	7.6	5.2
PENSACOLA	AUTUMN	572.5	28.6	20.0	6.4	16.2	15.5
HILO	SUMMER	745.7	81.8	9.1	12.7	20.9	17.0